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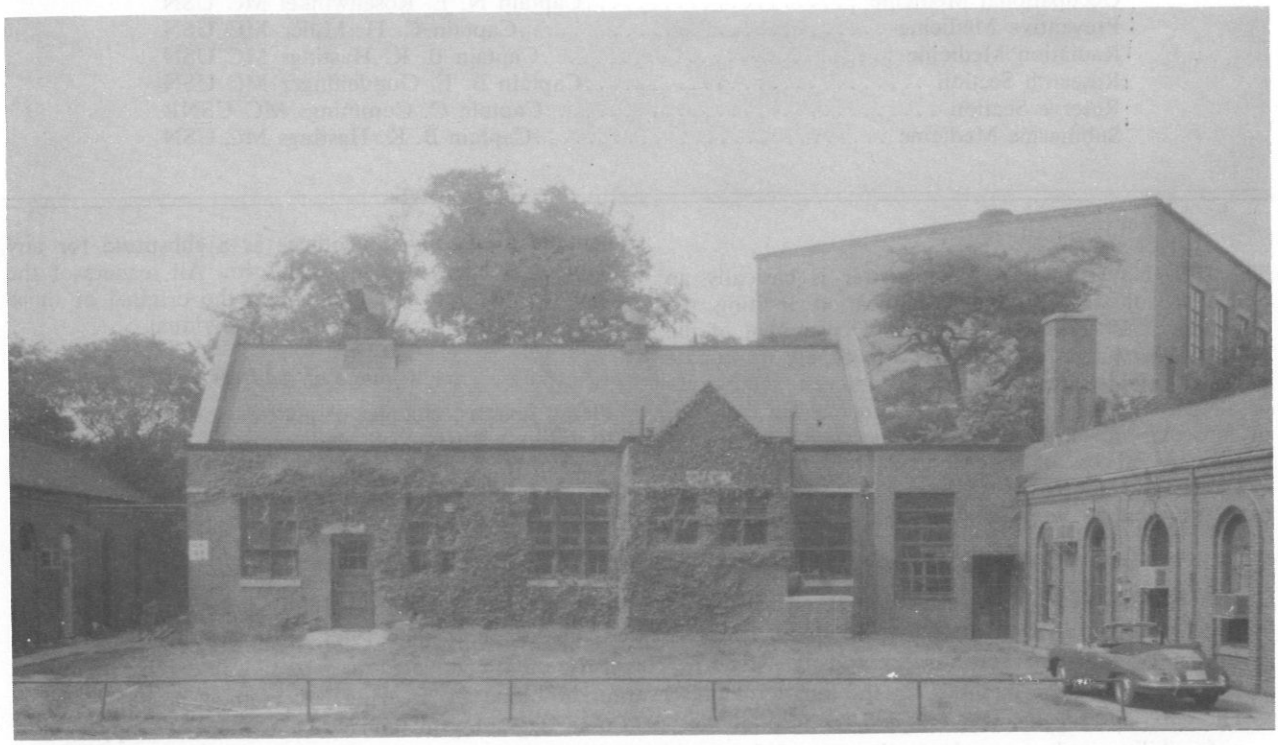

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Policy

The U.S. Navy Medical News Letter is basically an official Medical Department publication inviting the attention of officers of the Medical Department of the Regular Navy and Naval Reserve to timely up-to-date items of official and professional interest relative to medicine, dentistry, and allied sciences. The amount of information used is only that necessary to inform adequately officers of the Medical Department of the existence and source of such information. The items used are neither intended to be, nor are they, susceptible to use by any officer as a substitute for any item or article, in its original form. All readers of the News Letter are urged to obtain the original of those items of particular interest to the individual.

Change of Address

Please forward changes of address for the News Letter to Editor: Bureau of Medicine and Surgery, Department of the Navy, Washington, D.C. 20390 (Code 18), giving full name, rank, corps, old and new addresses, and zip code.

FRONT COVER: NAVAL BLOOD RESEARCH LABORATORY. The Naval Blood Research Laboratory was established at the Naval Hospital, Chelsea, Mass. on 23 September 1965. Prior to that time the Bureau of Medicine and Surgery and the Office of Naval Research conducted an extensive research program to test and evaluate methods for the long-term preservation of blood by freezing. A method developed by Dr. Charles Huggins was adapted to hospital and field use. Beginning in January 1966 BUMED supported a feasibility study to evaluate the use of frozen blood banks in combat areas ashore and afloat. Such banks are currently operating aboard the hospital ships USS REPOSE, USS SANCTUARY, at the U.S. Air Force Hospital at Clark Air Force Base in the Philippines, and at the Navy Station Hospital, DaNang, South Vietnam. The blood bank at DaNang is contained in a mobile trailer unit. Frozen blood has several advantages. It makes large quantities of all blood types available for emergency medical treatment. Moreover, since whole blood normally is good for only 21 days and then must be discarded, much unused blood is wasted in this manner. But when blood is preserved by freezing for up to 4 years, hospitals can keep a reserve supply of blood without having to discard outdated blood. Group "O" Rh negative red cells are frozen in polystyrene bag containers using dry ice as the refrigerant. Glycerine is the preservative medium. When the blood is reconstituted the cytoglomerator is used to separate the glycerine from the red cells. Blood can be administered within 1 hour after thawing and has been found to be effective and safe when given in large volume. In one instance a Marine casualty received 93 units of blood, 41 of which were reconstituted frozen blood, and survived. The preparation of blood for freezing tends to eliminate the transfer of agents which cause hepatitis; and usually from 87 to 95 percent of the frozen red cells survive as compared to 70 percent in previous systems. Trials with patients who had violent reactions to acid citrate dextrose preserved blood transfusions have shown the patients can tolerate blood preserved in the new way.

The issuance of this publication approved by the Secretary of the Navy on 4 May 1964.

RECENT ADVANCES IN THE STUDY OF PERIPHERAL NEUROPATHY

S. I. Zacks, MD, Ayer Clinical Laboratory, Pennsylvania Hospital, Philadelphia, Med Sci 18(12):52–58, December 1967.

This article summarizes current knowledge of nerve structure and describes some common features of neural pathology illustrated by recent research employing chemical and ultrastructure techniques.

Peripheral neuropathy occurs in a bewildering variety of clinical forms with widely differing etiology. Polyneuropathy refers to involvement of multiple nerves, either in a symmetrical or asymmetrical pattern. In the symmetrical form, symptoms occur in the legs early in the course of the disease because the longest neurons are affected first. Later the arms and rarely the face become involved. In the asymmetric form, the periphery may not be affected before the more proximal parts of the limbs.

The clinical signs of polyneuropathy include weakness and wasting of striated muscle, occasional fasiculations and bony deformities resulting from chronic muscle weakness. The deep tendon reflexes may be reduced or absent. Sensory involvement may be absent, slight or severe. Paresthesia, numbness, tingling and burning sensations may be present. Following sensory loss of long duration, trophic changes in the skin, finger nails, and hair occur, and ulcers may be present on the feet. Electromyographic study often reveals partial denervation, fibrillation potentials, and decreased neural conduction times. Low amplitude potentials may be observed on voluntary effort.

Peripheral neuropathy occurs in association with many diseases. The purpose of the present brief review is to summarize current knowledge of nerve structure and describe some common features of neural pathology illustrated by recent research employing chemical and ultrastructure techniques. This may help to elucidate some of the clinical phenomena underlying the neural lesions.

Syndromes in which peripheral neuropathy occur are summarized in the table which is modified from Elliott. In most cases, too little is known of specific mechanisms to permit more than a tentative classification.

Etiologic Factors in Peripheral Neuropathy
(Modified from Elliott)

I. *Infections:* Diphtheria, herpes zoster, infectious mononucleosis, leprosy, fevers of long duration, viral hepatitis, acute febrile polyneuropathy.

II. *Allergic:* Serum neuropathy.

III. *Metabolic:*

A. *Toxic:* Metals (Sb, As, Au, Pb, Mn, P, TI.) misc.: barbiturates, benzene derivatives, carbon monoxide, carbon tetrachloride, DNP, isoniazid, tetraortho cresyl phosphate, thalidomide, etc.

B. *Deficiency:* Alcoholic polyneuropathy, beriberi, pellagra, subacute combine degeneration of spinal cord.

C. *Heredofamilial:* Diabetes, hypertrophic neuritis (Dejerine-Sottas), Refsum's disease, familial recurrent neuropathy, amyloidosis, metachromatic leukodystrophy.

D. *Miscellaneous:* Amyloidosis, hyperinsulinism, macroglobulinemia.

IV. *Unknown Etiology:* Collagen disease (disseminated lupus, polyarteritis nodosa); acrodynia, neoplastic neuropathy, sarcoidosis, porphyria.

This collection of disease entities cannot be discussed in detail because of limitations of space. However, it is clear that peripheral nerve can respond to injury in a limited number of ways. We must therefore first examine the histopathologic final common pathway leading to the observed nerve lesions before attempting to analyze the underlying defects leading to the formation of lesions.

The results of numerous investigations utilizing the light microscope have defined the major types of reactions of peripheral nerve to injury. Two major forms of peripheral neuropathy can be identified: Wallerian degeneration, and acute or segmental

demyelinization. A third, uncommon lesion is hypertrophic neuropathy with "onion bulb" formations. In recent years, classic methods available for study of the diseases of peripheral nerve have been greatly augmented by the availability of the electron microscope and correlated biochemical studies. These constitute powerful new tools for analysis of the pathogenesis of these lesions.

Before discussing these lesions, a review of the microscopic and ultrastructure anatomy of peripheral nerve may be useful as a background for consideration of the responses of peripheral nerve to injury.

Microscopic Anatomy of Peripheral Nerve

As will be recalled, the motor component of mixed peripheral nerves arises from cell bodies lying in the anterior horns of the spinal cord, and the sensory component consists of fibers whose neurons lie in the dorsal sensory ganglia. Various autonomic components are also present in the mixed peripheral nerve. Thus, anterior, dorsal, and ventral root fibers are grouped together in bundles to form the peripheral nerves. A connective tissue sheath, the epineurium, encloses the entire nerve. Within the nerve, each bundle of nerve fibers measuring 1 to 30μ in diameter are enclosed by a connective tissue sheath called the perineurium. Although once believed to be connective tissue (endoneurium), the cells associated with the individual nerve fibers within individual bundles are now recognized as Schwann cells and relatively infrequent fibrocytes. Discussion of the controversy concerning the various connective tissue components of peripheral nerve would be inappropriate in this review.

In general, the velocity of impulse conduction and the amplitude of the action potential varies directly with the diameter of nerve fibers. Three major groups of fibers have been identified in peripheral nerve. The A fibers, with conduction times of 15-100m./sec., are motor and sensory; B fibers (3-14m./sec.) are chiefly visceral sensory fibers, and C fibers (0.5-2m./sec.) include unmyelinated autonomic and some sensory fibers. The motor fibers supplying skeletal muscle are the largest and most heavily myelinated, whereas fibers innervating visceral smooth muscle are thin and lightly myelinated or appear to lack myelin when viewed in the light microscope. Fibers mediating external sensibility are of medium size and moderate degree of myelinization, whereas pain and taste fibers tend to be thin with less myelinization or none at all visible in the light microscope.

A striking feature of peripheral nerves in the light microscope are the myelin sheaths that surround each axon. Originally, it was believed that the myelin sheath was a separate structure that was independent from the adjacent cellular layer. However, electron microscopic studies have clearly demonstrated that myelin is actually an integral part of the Schwann cell. Electron microscope studies have revealed that the myelin is composed of closely packed lamellae composed of mixed lipids alternating with protein with a period of 130 to 150Å. The work of several investigators has demonstrated that this sheath is derived from the double plasma membrane of the Schwann cell and appears to result from spiral wrapping around the axon. The number of turns range from 1 to 2 in small fibers to 50 or more in large fibers. A similar relation exists in the central nervous system, where the oligodendroglia correspond to the Schwann cell in the process of myelinization. During myelinization of the peripheral axons, the naked axon comes in close relation to a Schwann cell. The latter develops an invagination in which the axon lies. Subsequently, additional layers of Schwann cell membrane surround the axon. An external mesaxon can be demonstrated marking the point of original invagination. There is also a corresponding internal mesaxon. The axon, representing a continuation of the cytoplasm of a neuron often many centimeters distant, contains tubular profiles, mitochondria and occasional granules lying in an apparently watery matrix. At the interfaces between adjacent Schwann cells, the axon is covered by Schwann cell processes but no myelin, an area termed the node of Ranvier.

Many studies show that the function of the nerve is to conduct stimuli from the cell body by means of a propagated electrical depolarization mediated by ionic changes in the membrane. It has become increasingly clear in recent years that the Schwann cell, in addition to its role in initial myelinization and remyelinization after injury, plays an important role in the maintenance of the axons. In the consideration of the pathology of the various forms of neuropathy that follow, it should be emphasized that although we focus our attention on the peripheral nerve, the entire motor unit with its cell body, peripheral axon, Schwann cells, connective tissue investments and site of peripheral innervation together form a functioning unit. Injury anywhere along the axis of this unit may result in pathologic changes in the other components. For example, a disease primarily affecting muscle can, by destroying sites of innervation, produce neural atrophy, and correspondingly,

a primary disease of the cell body resulting in destruction of axons may be followed by destruction of myelin.

Pathology of Peripheral Neuropathy

If the basic anatomy of the motor unit is considered, it appears that the beginning toward making some order out of the confusing varieties of peripheral neuropathy might be achieved by considering which disease entities primarily involve the cell body and its extension, the axon and which primarily affect Schwann cells. It is in these terms that the classically identified forms of neuropathy, Wallerian degeneration, segmental demyelinization and hypertrophic neuritis may be initially interpreted.

Wallerian Degeneration

In 1850, Waller described the characteristic changes that occur in peripheral nerve following transection or crush injury. He observed the destruction of the distal myelin and axon followed later by regeneration and reinnervation. A common clinical example illustrating this process is a traumatic nerve lesion. The immediate result of crush or transection of the nerve is degeneration of the tissue directly affected. During the following days, secondary (Wallerian) degeneration affects the entire length of the nerve distal to the point of injury. The axon and its myelin sheath are destroyed in a characteristic series of stages. Following section or crush injury to the nerve, the distal axons become swollen in 1 to 3 days and proceed to degenerate. By the end of this period, the proximal ends of the axons are already beginning to send out minute regenerative sprouts. During the first week, broken segments of myelin, discontinuous ovoids, Schwann cell proliferation, and phagocytosis of myelin debris dominate the histological picture. Destruction of axons appears to precede myelin breakdown.

A moderate increase in connective tissue forming a scar may occur at the site of the lesion. During the second week, the myelin ovoids break into small globules composed largely of neutral fat which are gradually removed by phagocytes. Within the neuron cell body, maximum chromatolysis occurs by the second week. At this time, the process of regeneration becomes prominent. New axons, moving at aproximately 1 to 2 mm. per day and closely associated with the Schwann cells, are present. Although some of the Schwann cells have been destroyed, others remain. The survivors proliferate and with the surviving basement membranes of the original cells form a Schwann tube that serves as a guide for the regenerating axons. The regenerating axons come into close relation to the Schwann cell processes. The Schwann cells enclose the axons and begin the process of remyelinization which becomes visible by the third week. During the following weeks, distal axons increase in length, diameter and their myelin sheaths become thicker. Eventually their connection with the periphery is re-established. However, the size, distribution and absolute size of fibers in the peripheral nerve may never be restored. The degree of restoration of function depends on the nature of the injury, the degree of separation, the accuracy of reapposition of the cut ends and the presence of intervening connective tissue. In general, clean-cut nerves, accurately sutured together require somewhat longer to regenerate than merely crushed nerves, whereas widely separated lacerated nerves sutured after some delay take the longest time to regenerate. Restoration of peripheral connection may not occur in some cases if fibrous tissue has blocked the re-innervation pathway. Recently, Lehman and Hayes have experimented with several techniques to facilitate neural regeneration.

An implication of the process described above is that reversibility occurs. It is clear however that in diseases affecting spinal neurons leading to complete destruction of the cells, Wallerian degeneration will occur but regeneration will not be possible. Conditions which may destroy spinal neurons include various viral infections (poliomyelitis) or the destruction may result from other forms of injury where the pathogenesis is less well understood (porphyria).

In peripheral neuropathy caused by herpes zoster infection, Wallerian degeneration may result from destruction of sensory cell bodies within ganglia. It is also probable that nerve fibers may be attacked directly within peripheral nerves since intraneural inflammation has also been observed. An interesting aspect of this process is the late stage of neural fibrosis that transforms the peripheral nerves into nearly a solid mass of fibrous tissue containing rare small myelinated axons. The degree of fibrosis does not correlate with the occurrence of post herpetic neuralgia.

Schlaepfer et al have demonstrated that axon destruction precedes myelin breakdown in experimental isoniazid induced neuropathy. Initial changes in the axons included swelling of mitochondria, coarse granular alterations of axoplasm and double membrane bound sacs and dense bodies in the axoplasm.

Following destruction of the axons, the myelin lamellae collapse and degenerate.

Segmental Demyelinization

In the process of segmental demyelinization, the major process is focal demyelinization resulting in focal denudation of the axon. This pathologic process appears to be implicated in an increasing number of disease processes including various toxins (diphtheria, lead), peroneal muscular atrophy, diabetic and carcinomatous neuropathy. According to Thomas and Lascelles, in diabetic neuropathy the first histological lesion visible is widening of the nodal gaps between the Schwann cells, followed by formation of short myelinated internodal segments. This process results in the appearance of shorter segments in teased osmium-stained preparations which are particularly useful in the identification of segmental demyelinization. In a study of diphtheric neuritis, Webster et al reported that lesions first appeared in the Schwann cell membrane systems including the surface mesaxon and myelin sheaths. The axon cell membranes were also affected. The earliest changes occurring at the onset of weakness were the appearance of myelin loops at the nodes, changes in the surface layers of compact myelin adjacent to the Schmidt-Lanterman incisures and variations in the contour of the myelin sheath. Later focal myelin fragmentation and irregular densities in the Schwann cell cytoplasm occurred. Still later, extensive myelin breakdown with ovoids and debris within fragmentized mesenchymal cells were present. In some unmyelinated fibers, and a few myelinated fibers, destruction of axons was also visible. Remyelinization took place approximately two weeks later. Recently, Thomas and Lascelles have reported segmental demyelinization occurring in diabetic neuropathy, and Croft et al described similar changes in several patients with carcinomatous neuropathy. Clinically, local segmental demyelinization of function may be revealed by reduced conduction times. Recovery may be relatively rapid.

A reasonable hypothesis is that segmental demyelinization results from focal disease of Schwann cells either as a result of an infectious agent, toxin, or a hereditary biochemical abnormality. Schwann cell abnormalities have also been observed in metachromatic leukodystrophy, a genetically determined neurolipodosis with diffuse demyelinization, decrease in total lipids (including myelin lipids) and increased sulfatides; it is therefore an inborn error of glycospingolipid metabolism. In studies of lipid metabolism in nerve poisoned with diphtheria toxin, Majno et al have shown that approximately one day before segmental demyelinization could be demonstrated histologically, a slow decline in the total lipid content and oxygen uptake occurred. Incorporation of acetate into total lipid was greatly decreased as early as 24 hours.

Hypertrophic Neuritis

An unusual form of peripheral neuropathy, hypertrophic neuritis, is characterized by many clinical patterns which commonly have features of nerve thickening and muscle wasting. Although both motor and sensory involvement usually occur, sensory function may be largely spared. Patients with onset of the disease in childhood may be distinguished from patients whose onset was in later life. Grossly the nerves show a striking enlargement in some and hardness in others. A characteristic microscopic feature is the presence of whorls of circumferentially oriented Schwann cells surrounding a centrally placed myelinated or unmyelinated axon. These "onion bulb" lesions vary greatly in frequency in various reported cases although all the cases show decreased numbers of myelinated axons, particularly the larger ones. In recent electron microscopic studies of hypertrophic neuritis, the Wallerian type of degeneration was observed by one group whereas segmental demyelinization was observed by others.

The "onion bulb" lesion is not clearly specific for a single clinical entity. For example, Refsum's syndrome, which includes hypertrophic polyneuropathy, atypical retinitis pigmentosa, ichthyosis, and nerve deafness also is associated with onion bulb lesions. In recent years an abnormal branched chain fatty acid (phytanic acid) has been found in the serum and tissues of these patients. Therefore, Refsum's disease, which has a recessive inheritance pattern, differs from the irregular dominant inheritance and varying penetrance of the classical Dejerine-Sottas polyneuropathy. Refsum's disease now must be classified as a kind of lipid storage disease, possibly involving Schwann cells. More studies are required before the histogenesis of the "onion bulb" lesion can be explained with certainty. An hypothesis that would explain the current data is that the amorphous material surrounding the bulbs and the abnormal Schwann cells surrounding surviving or regenerated axons in the bulb lesions result from a primary, possibly genetically determined, or an acquired defect of the Schwann cells.

Summary

As a working hypothesis, it seems likely that two major pathologic responses can be identified in peripheral neuropathy. The first, based on the classic model of Wallerian degeneration, is characterized by a primary destruction of the axon either simply by trauma as in nerve section or as a result of one of many disease processes (e. g., poliomyelitis) affecting the neuron. Myelin alterations in such cases appear to be secondary. The second process, segmental demyelinization, appears to result from either congenital or acquired disease of Schwann cells that may be expressed in the inability to make or maintain the myelin sheath. Axonal lesions in these cases may be secondary to the myelin abnormality. Hypertrophic neuritis may be a chronic form of segmental demyelinization.

As more cases of peripheral neuropathy are examined with modern techniques of ultrastructure analysis and correlated biochemical studies, the prospect of clarifying the underlying mechanisms in the etiology and histogenesis of these lesions is hopeful. Particularly, attention must be directed to the metabolism of Schwann cells in the various neuropathies. The discovery of abnormal lipids in a genetically determined peripheral neuropathy (Refsum's disease) may also contribute laboratory methods for the early recognition of affected individuals. A careful clinical correlation with pathologic studies of affected nerve will form the foundation for the future analysis of the numerous forms of polyneuropathy.

(The omitted figures and references may be seen in the original article.)

THE PSYCHIATRIC EMERGENCY: A DIAGNOSTIC CHALLENGE

Abraham J. Twerski, MD, Pittsburgh, New Physician
17(2):29–31, February 1968.

With the ever-increasing demand on the emergency room staff for diagnosis, treatment, and disposition of patients with various types of acute illnesses, suggestions for expediting and clarifying diagnosis should be of help. The following discussion of organic pathology presenting with mental symptoms is based on two years' experience in the emergency room of a general hospital, which had been serving as virtually the psychiatric receiving center for a large metropolitan population, with an annual turnover of approximately 2,400 "psychiatric emergencies."

Emergency Room Role

The writer recalls that in his orientation to emergency room service as an intern, the surgeon's instructions regarding abdominal complaints were. "All you have to diagnose is whether the patient has a surgical abdomen or not. The further differential diagnosis is our problem, not yours."

The psychiatrist's position is similar to this. All that need be determined is whether the problem at hand constitutes a psychiatric emergency. The more sophisticated details, as to specific diagnosis, etiology, or definitive therapy, need not be the concern of the emergency room physician.

Diagnostic Pitfalls

It might seem that the task should then be a relatively simple one, inasmuch as abnormal thought or behavior, when present, is usually quite apparent or can be elicited by a few simple questions. However, aberrant thought or behavior may at times be the presenting symptom of somatic illness. Where organic pathology is responsible for the symptoms, it is of particular importance that the correct diagnosis be made, not only to enable prompt treatment of the disorder, but also, since disposition may be to a public mental hospital which often operates with a skeleton crew, the presence of a subtle organic disorder may not be readily detected. Furthermore, once the diagnosis of "mental illness" is made, the index of suspicion of the subsequent physician for organic pathology is generally lowered, thus further postponing proper diagnosis.

Patients suffering cerebral vascular accidents involving the dominant hemisphere often become aphasic. When a receptive aphasia exists, the patient's ability to comprehend what is said to him is impaired to a greater or lesser degree. Since the patient is unable to understand the question put to him, his responses will be irrelevant. The "non-

sensical" responses may be mistaken for psychotic communication. Where there is an accompanying hemiplegia or hemiparesis, there is not much diagnostic confusion. However, if the ischemic process spares the motor cortex, with the only prominent symptom being the "nonsensical" conversation, the diagnosis of cerebral vascular accident may be overlooked, and the patient considered psychotic.

Absence of motor dysfunction may be particularly misleading in transient ischemic episodes involving the carotid artery system. It should be remembered that orientation to one's environment and the ability to communicate one's thoughts and needs to others are so central to the personality that the perception of even temporary loss of these faculties, as in a transient ischematic episode, may bring about extreme agitation, depression, hostility, combativeness, and explosive anger, in addition to the confusion and disorientation. It is altogether possible that by the time the patient is examined the transient ischemia has passed, with only the psychological reaction persisting. As pointed out below, the correct diagnosis can be made, and is of extreme importance, since the etiological factors can often be properly treated, whereas commitment to a mental hospital may obscure the true picture.

Cerebral ischemia of a degree sufficient to cause mental aberration may result from impaired circulation due to cardiac decompensation. Again, when other symptoms of heart failure are prominent, the diagnosis is simple. Occasionally, however, the mental symptoms of agitation and confusion predominate, and obscure the diagnosis of heart failure. The writer recalls a patient diagnosed as an agitated depressive because of her anorexia, insomnia, and restlessness, who was found to be in congestive heart failure, and whose symptoms cleared with restoration of compensated cardiac function. The same findings may result from cerebral ischemia due to severe anemia.

Several patients presented as senile psychoses, who were found to be severely azotemic. This is a particularly difficult diagnosis to make in the emergency room, since it is hardly feasible to do routine blood-urea-nitrogen determinations. Yet the condition may be completely reversible, as with obstructive uropathy, and the symptomatology may clear completely with proper treatment.

A patient who was found to be wandering around aimlessly as if in a daze may be brought in by the police. Interview may reveal disorientation and severe confusion. It is not unusual to find that the patient suffered a convulsive seizure and was in a state of postictal confusion when taken into police custody. The patient's poor contact with his environment may easily be mistaken for schizophrenic disorganization.

Systemic or central nervous system infections can present as severe behavior disorders. Although it might appear that the diagnosis of an infectious process should present little difficulty, the fact is that the patient may be so agitated that adequate examination is not easily accomplished. The writer recalls two patients who were brought to the hospital by police because of severe agitation and combative behavior. It was impossible to do a satisfactory physical examination or even have the temperature taken. After adequate sediation and with the assistance of several attendants, examintion revealed one patient to have nuchal rigidity and a fever of 104 F. Lumbar puncture revealed a purulent meningitis. The second patient, also febrile, was found to have Friedlander's pneumonia. It is evident that had these patients been diagnosed as psychotic and admitted to a psychiatric hospital where prompt examination was not available, or where it might have been assumed that organic illness had already been ruled out, these patients could have succumbed to their infectious processes.

Patients with decompensated hepatic disease, such as the cirrhotic in hepatic pre-coma, may have severe mental confusion and restlessness, which may at first be mistaken for a functional behavior disorder. Also, patients with primary or metastatic cerebral neoplasms may have behavioral symptoms, which, in some cases, are the initial symptoms of the malignant process.

Toxic conditions are usually identifiable, and some of these, such as alcoholic hallucinosis, barbiturate or other depressant drug withdrawal, or psychosis with hallucinogenic drugs, should indeed be treated in a psychiatric setting. The important point to remember here is that when the patient presents symptoms of a withdrawal syndrome related to use of barbiturate or other depressant drugs such as glutethimide, meprobamate, chlordiazopexide, etc, treatment of the withdrawal syndrome should begin immediately. If several hours are to elapse before admission to a psychiatric hospital is accomplished, the untreated withdrawal patient may arrive there in a state of acute brain syndrome with convulsions, and present a serious medical emergency.

Bromism is occasionally encountered and may present an acute mental illness. Two cases of bromism were seen in the past year, one in a state of severe

confusion with profound weakness, and the other in an acute paranoid state. Neither had any cutaneous manifestations, and the diagnosis was by laboratory tests, after the history by the family revealed frequent use of "nerve medication." Hypoglycemia secondary to insulin reaction rarely presents a diagnostic problem. Patients with hyper- or hypothyroidism may occasionally present with symptoms of manic hyperactivity or severe depression, respectively.

A word of caution in regard to alcoholic patients is worth repeating. The intoxicated individual, because of his unsteadiness, is notoriously prone to sustaining head injury, and the latter must always be considered. Even if there are no signs of recent head trauma, the possibility of subdural hematoma from previous falls should be borne in mind. The prominence of an alcohol odor tends to distract attention from other possible pathology. The writer recalls two patients with pulmonary edema secondary to myocardial infarction who had the misfortune of sustaining their cardiac insult after a few drinks, and the assumption that their weakness and complaints were due to alcohol intoxication delayed effective treatment.

Diagnostic Hints

There are several guidelines of help in differentiating functional aberrant behavior from that secondary to organic pathology. First, and by far the foremost, is maintaining a high index of suspicion. In examining the "mental" patient, consideration of the most common physical illness which may manifest mental symptoms is of major importance in making the correct differential.

The maxim that the history is the most valuable diagnostic tool is certainly valid here as elsewhere. Information as to existing cardiovascular disease, convulsive disorder, drug ingestion, alcohol excess, or other preexisting conditions will alert the examiner to their possible etiological role in the case at hand. A history of previous psychiatric hospitalization is of significance.

The mode of onset of the mental symptoms is of particular importance. Sudden development of mental symptoms in an individual who had an apparently stable personality, as demonstrated by satisfactory adjustments to the challenges of daily living, should raise the suspicion that this may not be a functional illness. As an example, a 57-year-old male was brought to the emergency room by his wife, who stated that the patient had been brought home from work that day because he was "talking and acting crazy." The patient had no history of previous aberrant behavior, had worked regularly at this job for the past 23 years, did not use alcohol excessively, and had appeared his usual self when he left for work that morning. *Functional mental illness simply does not develop in this manner,* and the history itself was virtually diagnostic. Examination revealed no motor weakness or pathologic reflexes, but the patient was found to have a marked receptive aphasia. Subsequent angiography revealed occlusion of the left middle cerebral artery with retrograde filling via the anterior cerebral artery, the latter undoubtedly accounting for the sparing of the motor cortex.

A history of transient episodes of confusion or speech difficulty with or without motor weakness, possibly accompanied by agitation or belligerence, usually in an individual beyond the fourth decade, is virtually diagnostic of cerebral vascular insufficiency. Inasmuch as examination may reveal nothing other than agitation or depression, the diagnosis rests on history, and the latter should be obtained before a diagnostic impression or disposition is made.

The chief mental symptomatology of the organically sick patient consists of disorientation, especially in time, memory impairment, confusion, and fluctuating levels of consciousness. A schizophrenic patient may be confused, but hardly to the degree that he does not know the month or year, or how he was brought to the hospital. He may be withdrawn and hesitant in response to questions, but his facial expression does not show the obtundation of the patient with cortical impairment. Even a severely disorganized psychotic will be able to name simple objects, and the presence of an anomia or alexia, for example, indicates organic impairment. The chronic, severely disorganized schizophrenic who may have severe intellectual impairment and thus resemble the organic, is not likely to present as an emergency.

While visual hallucinations may occur in the functional psychoses, they should always alert one to the possibility of an organic condition, particularly a toxic reaction. Purposeless motor activity is frequent in organic conditions. Motor manifestations in schizophrenia, while bizarre and irrational, show some sign of being symbolic or meaningful to the patient, and the motor activity of the agitated depressive is usually pacing or hand-wringing, whereas the organic patient has undirected, purposeless, restless, or thrashing movements.

The patient with a convulsive disorder may carry some type of medical data card, and this should be looked for. He often carries anticonvulsant medication with him, and the writer knows of several cases

where the finding of white capsules with a red band in the patient's possession, easily recognized as diphenylhydantoin, enabled the emergency room nurse to make the correct diagnosis. Evidence of tongue biting or incontinence may indicate the etiology of the state of confusion. Where postical confusion is considered a possibility, allowing the patient to rest in the emergency room for several hours is a diagnostic test.

The patient should always be asked if he takes medication, and every attempt should be made to identify the medication. People who use depressant drugs to excess are notoriously prone to deny the extent of their habit, and questioning of the patient and family should be vigorous. Almost all of these drugs produce horizontal nystagmus, which should be looked for. Sites of self-injection should be looked for because, although narcotics do not generally cause disturbed behavior, the addict may be using barbiturates or amphetamines in conjunction with or in lieu of narcotics, and withdrawal or excess of these drugs may be etiologic. As pointed out above, this diagnosis should be made prior to disposition.

Adequate examination is imperative, and disposition of a patient to a mental hospital without proper examination because the patient was "too agitated" to be examined is inexcusable from a medical standpoint, as well as being a medical-legal hazard. The patient can be sedated with phenothiazines or intravenous sodium amytal if this is necessary to allow proper evaluation. If laboratory studies are necessary for diagnosis, as when uremia or bromism is suspected, the patient may be detained in the emergency room with proper sedation, while the laboratory report is awaited.

Psychotic Symptoms of Somatic Origin: A Bizarre Example

Anecdotally, a middle-aged female presented with the complaint, "I've got a nail down the middle of my head." This is a classic complaint in the rare conversion disorder, "clavus hystericus." However, the x-ray revealed that this was not clavus, but rather the result of a psychotic gesture, in which the patient succeeded in driving a nail through the skull, and remarkably enough without evident tissue damage.

Summary

Mental aberrations are occasionally the only or most prominent symptoms of serious organic disorders. The most common diagnostic problems, in the writer's experience, are presented, along with suggestions for facilitating differential diagnosis.

(The omitted figures may be seen in the original article.)

CARDIOVASCULAR SURGERY, ANESTHESIA, AND PULMONARY PROBLEMS

Frank Cole Spencer, MD, FACS New York, New York,
Surg Gynec Obstet 126(2):275–280, February 1968.

A current major activity in myocardial revascularization is determining what type of arterial implant should be utilized, especially to revascularize the posterior portion of the left ventricle. One popular technique is the use of both internal mammary arteries: implantation of the right internal mammary artery into the anterior surface of the left ventricle and of the left internal mammary artery into the posterior surface of the left ventricle. Others have used the gastroepiploic artery, bringing the vessel from below the diaphragm upward to the left ventricle. Recently, the splenic artery, as evaluated experimentally by Bloomer several years ago, has been implanted in several patients. The attractiveness of the splenic artery is partly related to its size and also to the fact that the hilar branches can be selectively implanted into both the anterior and posterior walls of the left ventricle. Long term data regarding the effectiveness of the procedure are not yet available.

The contribution of arterial implants to myocardial function remains an important consideration. Clearly, most implants will remain patent in a great percentage of patients, but the critical questions are the amount of flow through the implant and the importance of this flow to myocardial function. With the use of a mathematical model for analyzing re-

gional blood flow with radioactive krypton or xenon, Norman found a progressive increase in blood flow in internal mammary artery implants to levels of 50 percent of normal flow in the anterior descending artery 6 months after implantation. By contrast, Barner found in dogs studied several months after implantation that flow in the internal mammary artery was only 1 to 8 milliliters per minute which constituted 1 to 5 percent of total coronary blood flow, without any alteration in cardiac function when the implant was occluded. The conflicting conclusions obtained by different investigators emphasize the need for additional studies in the field, especially with better methodology for measuring regional changes in myocardial blood flow.

Two recent technical innovations have been described which may be of significance. Zubrin and his associates developed a method of maintaining patency of prosthetic arterial grafts implanted in the myocardium, an 8 millimeter dacron graft being implanted as a U-shaped vessel to maintain continuity of flow through the vessel. The grafts remained patent, but only meager connections developed with the coronary arteries. If prosthetic grafts could be employed, myocardial revascularization would be greatly facilitated, but previous studies have consistently revealed a prohibitive rate of thrombosis in prosthetic grafts. Davies has described an ingenious technique for rapid anastomosis of a coronary artery with a systemic artery, an arterial graft being anastomosed directly to the epicardium surrounding a coronary artery, which was divided immediately before completion of the surrounding anastomosis. Studies several months postoperatively indicated a patent vessel in each animal. If such a method of anastomosis were feasible in man, it would greatly facilitate coronary operations because, at present, direct anastomosis to a coronary artery is a tedious procedure which requires hypothermia or cardiopulmonary bypass to quiet the heart for a long enough period to perform a precise anastomosis with tiny sutures.

Sawyer has described pioneering studies with gas endarterectomy with carbon dioxide for coronary occlusive disease, but the few attempts in man have thus far been associated with a high mortality.

A serious responsibility exists with all investigators studying myocardial implantation, for many critical questions remain unanswered. These include the magnitude of blood flow which can be developed through an arterial implant and its relationship to myocardial function. Can the operations protect from the expected mortality rate from coronary occlusive disease, and can cardiac function be improved? The consequences of such a decision are far reaching because with the prevalence of coronary artery disease in millions of people, 1 of 2 conclusions should be reached. Either the operations are of little benefit and should rarely be performed, or conversely, there is significant benefit from such operations and millions of people with coronary occlusive disease should be operated upon. If this were found to be true, such operations would quickly become the most widely needed operative procedure in cardiovascular surgery.

The major limitation of current prosthetic cardiac valves is thromboembolism. The 2 principal areas of investigation to avoid thromboembolism are the evaluation of homograft valves and the development of cloth-covered prostheses to permit complete coverage of the internal surface of the valve with a neointima. Since thrombi develop at the junction of the metallic surface of the prosthesis with the intima covering the cloth of the prosthesis, a cloth-covered prosthesis may avoid thrombi by becoming completely covered with a neointima. Twenty such mitral prostheses have been inserted by Morrow and his associates, but long term data are not yet available. Similar aortic prostheses are now being used.

Morrow has recently described experiences with 133 patients with aortic valve prostheses with a 15 percent hospital mortality rate and a 15 percent late mortality rate, a number of the deaths being due to thromboembolism. Functional results were good in the surviving patients. Eight of the late deaths occurred suddenly, often with no abnormal postmortem cardiac findings except myocardial hypertrophy. Presumably, these deaths are the result of arrhythmia from cardiac hypertrophy and may be avoided only by earlier operation upon such patients. Until prosthetic valves are available with a lower incidence of thromboembolism, however, earlier operation cannot be soundly recommended.

Studies with homograft valves have, thus far, principally been with aortic valves. Kirklin reported experiences with aortic homograft valves in 81 patients with a recent operative mortality rate of 4 percent. The incidence of aortic insufficiency has greatly decreased with the use of gamma sterilization of the grafts, perhaps from less disturbance of tensile strength. No emboli have occurred. Long term studies of durability of such grafts in relation to subsequent development of aortic insufficiency are of great significance.

Ross has recently used an autotransplant of the pulmonic valve to replace the aortic valve in several

patients, the pulmonic valve being replaced with an aortic homograft. This ingenious technique has been performed in an attempt to avoid late degenerative changes observed in some aortic homograft valves. Theoretically, an autotransplant should be an ideal valvular prosthesis. Further observations will be awaited with great interest.

Duran has described experiences with 6 heterograft aortic replacements, with 2 hospital and 1 late death. These investigators used heterografts only when a suitable homograft was not available. It should be emphasized that the anatomic structure of the aortic valve varies in different species, some being more vascular than others and, accordingly, associated with a more intense inflammatory reaction after transplantation. Present evidence indicates that homografts are far superior to heterograft valves for replacement.

A serious question under evaluation is the proper method of sterilization and preservation of homograft valves. King reported that ethylene oxide did not uniformly sterilize such grafts, freeze-drying caused extensive disruption, and beta-propiolactone resulted in significant loss of tensile strength. Sterilization by gamma radiation seemed preferable, but long term studies about the fate of such grafts are not available.

Studies by Cleveland of 60 dogs with homograft aortic cusps well emphasize the importance of techniques of preservation. The valve homografts were obtained under sterile conditions and transplanted without sterilization or storage. Subsequent studies indicated that such grafts maintained a viable endothelium and fibroblastic activity. A mild immunologic reaction subsided within 2 months and did not impair function. Similar valves have been implanted in 3 patients. Similarly, Bigelow has reported excellent histologic preservation of aortic valves inserted 4 to 5 years earlier in 3 patients, all of whom had fresh aortic valve homografts inserted without sterilization or preservation.

Merendino has described a valuable laboratory technique for evaluation of different types of aortic valve homografts and found that hypothermia to 20 degrees C. permitted circulatory arrest for 1 hour in 50 dogs with a high percentage of survival. This technique provides a simpler approach for evaluating grafts than performing such experiments with cardiopulmonary bypass.

Homograft replacement of the mitral valve has progressed slowly. A recent publication by Flege described failure of mitral valve reconstruction with fascia lata in a carefully studied group of experiments with long term survivors up to 1 year. Extensive fibrosis ultimately destroyed the function of the valve. An encouraging development for mitral valve replacement has been described by Fuchs, who used metal frames to support aortic homograft leaflets which were then used to replace the mitral or tricuspid valve in 28 calves. These investigators have not applied this technique to man, but a recent report from England has described experiences with 17 patients in whom mitral valve replacement was performed with heterograft aortic valves from the pig which were supported on metal frames.

The important field of assisted circulation continues to attract widespread interest, with the evaluation of different methods, indications, and techniques. Significant data defining the indications for assisted circulation, as well as what benefits can be expected, however, are not yet available. Kantrowitz has used his pump for assisting circulation in 2 patients, both of whom died within a short period of time, 1 from extensive clot formation on the pump. DeBakey has described experiences with a pump for left ventricular-arterial bypass, used up to 10 days in 1 patient, in which the pump remained outside the chest while functioning and was subsequently detached from the patient. The critical problem with pumps for assisted circulation on a long term basis is the development of a pump which will not require the use of heparin. With available pumps, a serious risk thromboembolism occurs, unless heparin is employed; conversely, continued use of heparin on a long term basis is impossible because of the risk of hemorrhage. The development of the fabric lining, velour, by DeBakey and his associates is an encouraging step in this direction. In 1 patient in whom a velour-lined pump was used for 10 days without anticoagulants, signficant thrombi were not found. Whether or not similar favorable experiences will be found in other patients is yet unknown. The development of a pump, however, which would not require heparinization is the major technical advance needed in this field.

Techniques of counterpulsation have been greatly augmented by the development of the Simas pump which is carefully engineered to pump in coordination with the electrocardiogram, blood being aspirated during systole and blood being returned during diastole.

The best indication for the use of assisted circulation, at present, seems to be cardiogenic shock following a myocardial infarction or refractory arrhythmia after a myocardial injury. Application of any form of assisted circulation in association with

valvular replacement performed during cardiopulmonary bypass in a seriously ill patient is difficult to evaluate because many investigators have found that the most desperately ill patients will recover following valve replacement alone. Elective use of assisted circulation in such patients, hence, is almost impossible to evaluate and determine whether the patients would not have recovered without the use of assisted circulation.

The best technique of assisted circulation for cardiogenic shock following myocardial infarction is uncertain, but the simplest method is counterpulsation because of its availability and applicability without extensive operative intervention. Jacoby has presented an enthusiastic thesis that short periods of counterpulsation may enlarge myocardial collateral circulation. Such an hypothesis seems extremely unlikely on comparable physiologic evidence and would require careful documentation to substantiate such an optimistic, but remote, possibility.

The objective of assisted circulation following myocardial infarction is to decrease work requirements of the left ventricle until recovery occurs. The major questions are how much decrease in work requirements is necessary and how long circulatory support is required until recovery of the heart will be augmented? Unfortunately, until adequate pumps are available, the answers to these questions cannot be determined. Whether or not assisted circulation for 2 to 6 hours will be of benefit is uncertain. It may well be that significant help from assisted circulation will require its usage for several days or longer, until collateral circulation has developed about the acutely thrombosed coronary artery.

Experimental studies of an external cardiac compressor by Skinner, originally developed by Baue and his associates, have demonstrated that application of uniform external pressure to the heart can support the circulation for several hours. Although the applicability of such a device for assisted circulation in man is uncertain, it has obvious usage in the field of organ transplantation because it provides a precise method for maintaining circulation after death, until organs can be removed under appropriate sterile conditions for transplantation or preservation.

The obvious alternate choice to an artificial heart is a satisfactory cardiac homotransplant. Although clinical use of such a transplant may be far in the future, awaiting solutions to fundamental problems of homotransplantation which are common to those seen with transplantation of the kidney or the liver, encouraging advances have already been made. The most significant of these have recently been described by Lower, who, in association with Shumway, in a series of experiments has obtained survival of 2 dogs for periods of longer than 1 year, at which time the animals are physically healthy and active. Why success was obtained in these 2 animals which represent only a minority of the total experiments performed is uncertain. It is probably related to the fortuitous association of unknown tissue types. Sympathetic and parasympathetic nerve function returned within 3 to 6 months after homotransplantation. The fact that such a transplant can be successfully performed under any circumstances is most encouraging for future studies in this field.

Currently available pump oxygenators perform well when perfusion is needed for only 1 to 2 hours, and survival is frequently obtained after perfusions for 4 to 6 hours, although significant physiologic injury, fortunately usually nonfatal, can be demonstrated. Longer periods of perfusion with currently available pump oxygenators are not consistently possible. In the continued search for a better oxygenator, all evidence indicates that a membrane oxygenator which would avoid a gas-liquid interphase would be significantly better than present oxygenators which produce injury to plasma proteins and other components of the circulating blood. In the continued search for a membrane oxygenator, no oxygenator has exceeded a transfer rate of 30 milliliters per minute per square meter, requiring a membrane of 10 square meters for an adult with an oxygen consumption of 300 milliliters per minute. An encouraging development has recently been reported in this field by Illickal, who demonstrated that the limiting factor with a membrane oxygenator may not be in the permeability characteristics of the membrane itself but in the layer of stagnant blood immediately adjacent to the membrane which inhibits effective transfer of gas to surrounding blood. A technique for effective dispersion of this stagnant layer has been described which, if applicable to a clinical model, may represent a significant advance in this field.

The development of pulmonary lesions in association with cardiopulmonary bypass continues to be studied by several investigators. The basic phenomenon is yet unclear for similar findings have occurred following shock, prolonged use of artificial ventilators, and even with massive transfusion of blood. Recent studies described by Veith with the use of homologous blood have indicated that the

pulmonary changes can be produced by plasma following recirculation experiments in a pump oxygenator for several hours. The injuries are apparently associated with vasoconstriction of pulmonary veins.

Hakanson has studied another possible application of cardiopulmonary bypass, employing venovenous perfusion in dogs for 6 to 48 hours, with the possible clinical application of treatment of transient respiratory insufficiency. Diffuse nonfatal microscopic changes developed in the lungs in 75 percent of the animals, the cause of which is unclear. Development of such pulmonary lesions with venovenous bypass, however, is a serious impediment to the clinical use of such oxygenators because pulmonary function of a patient with pulmonic insufficiency might be harmed by the injudicious use of venovenous perfusion rather than improved.

A significant technical advance in the use of cardiopulmonary bypass has been the increasing use of routine cannulation of the ascending aorta for arterial perfusion during cardiopulmonary bypass. This technique avoids the occasional, but highly lethal, dissection of the aorta which may occur with retrograde perfusion through the femoral artery in older patients with atherosclerosis.

Because of the increasing use of pericardial grafts for cardiac reconstruction, especially for transposition of the great vessels, Danielson has compared the growth characteristics of pericardium with teflon fabric in 20 young pigs and 10 young calves. Large segments of the atrial wall were excised and replaced with either teflon or pericardium, and the growth characteristics of each material were compared when the animals were sacrificed several months later. There was a striking increase in the size of the pericardium in both groups, the increase being 2½ times original size in pigs and 5 times in calves, while there was naturally no enlargement of the teflon cloth.

Gudwin has proposed an interesting theoretical prognostic evaluation of cardiac reserve in older patients, calculating the physiologic ventricular volume from an indicator dilution curve with an equation developed by Newman. In a group of 40 older patients, ventricular mixing volume as an index of cardiac reserve correlated well with postoperative survival.

Reich has described current results of radiofrequency carotid sinus nerve stimulation in 12 patients with severe hypertension, some having been treated for as long as 14 months. Benefits have been apparent in some patients, although consistent results are not yet available. Long term evaluation of the efficacy of this unusual form of therapy will require a long period of observation.

The increasing use of epsilon-aminocaproic acid to prevent fibrinolysis during cardiopulmonary bypass prompted studies of the cardiac effects of this drug by Nolan. Precise studies of ventricular function demonstrated a consistent, positive inotropic effect with increase in myocardial contractility following administration of the drug, an indication of its safety when used following cardiopulmonary bypass.

Ebert has studied the many factors which influence cardiac arrhythmias after myocardial infarction produced by ligating the anterior descending coronary artery in dogs. Within 6 to 10 minutes after occlusion of the anterior descending coronary artery, there is a transient rise in potassium concentration in blood in the coronary sinus, followed several hours later by another transient potassium increase as potassium is lost from the myocardium. These transient changes in potassium concentration are often associated with fatal arrhythmias. Denervation of the heart by prior performance of a sympathectomy consistently prevented fatalities from such arrhythmias in the first 12 hours following ligation of the anterior descending coronary artery, although late fatalities at 48 and 72 hours from cardiac failure following infarction were not altered.

The site of proper implantation of a cardiac electrode when a cardiac pacemaker is implanted was studied by Tyers and associates. Cardiac function was best when the electrode was implanted near the apex of the left ventricle. Implantation into the right ventricle or the outflow tract of the left ventricle resulted in cardiac function which was 80 to 90 percent of that obtained when implantation was done at the apex of the ventricle.

Folkman has described an ingenious device for the intravenous administration of gas anesthesia utilizing the diffusion characteristics of methoxyflurane through silicone tubing. An indwelling arteriovenous shunt with silicone tubing, which was similar to that used for chronic hemodialysis, permits the intermittent administration of a gas anesthetic without the necessity for intubation or changes in respiratory function of the patient.

The treatment of carcinoma of the lung remains at an unsatisfactory stationary level without demonstrated improvement from ancillary chemotherapy or radiation. Preoperative irradiation has been of obvious value with the Pancoast tumor, Paulson and

associates obtaining 10 three year survivors and 9 five year survivors, the total survival rate being 35 percent. These patients routinely received 3,000 roentgens 2 weeks preceding operation. With the usual bronchogenic carcinoma of the lung, however, studies by several groups have thus far failed to show significant benefit from the use of preoperative irradiation in similar, or even greater, doses.

Injury of the lung from prolonged ventilation with high concentrations of oxygen is gradually being recognized with increasing frequency. Ventilation with concentrations of oxygen above 50 percent, with an inspired gas tension exceeding 300 millimeters of mercury will consistently produce fatal injury in dogs after 96 hours. How frequently such injuries may occur in man is unknown because a respirator is usually employed when pulmonary disease is already present. Serious mechanical errors in regulation of oxygen concentration have been found in almost all of the available respirators used, the errors resulting from the ancillary use of a humidifier nebulized with oxygen. Mechanical ventilators can be employed safely only by periodic measurement of oxygen tension in the gas ventilated into the patient rather than relying upon uncertain mechanical adjustments on the ventilator itself.

The increasing recognition of a "shock" lung has been described by several investigators. The occurrence of pulmonary lesions with shock, with cardiopulmonary bypass, and with oxygen injury may represent different modes of injury with a similar pathologic appearance. In critically ill patients, respiratory insufficiency continues to be a frequent and often fatal complication.

The widespread interest in low molecular weight dextran to decrease susceptibility to venous thrombosis led Chopra and his associates to evaluate the effects of low molecular weight dextran on the surface charge of blood vessels. The electrical charge on the intimal surface across a blood vessel, termed the "streaming potential," was evaluated after infusion of dextran and found to be increased threefold as the result of an increase in negative charge on the intima. As the negative electrical charge of the intimal surface is associated with inhibition of thrombosis, this change in electrical potential correlates well with clinical impressions regarding the effectiveness of low molecular weight dextran in decreasing susceptibility to thromboembolism.

Afshar and Bancoe have separately reported experiments in which the utilization of a negative charge on different materials in the blood stream has been employed to inhibit clotting. The electrical basis of thrombus formation has been well established by continued studies by Sawyer and associates who found that a negative charge inhibits clotting but a positive potential can induce clot formation.

Husni and associates have made potentially significant observations in the surgical physiology of venous insufficiency. Studies of ambulatory and standing venous pressure in patients with venous insufficiency from thrombophlebitis have demonstrated elevation of the ambulatory venous pressure to 100 to 150 centimeters of saline, while normal individuals have an ambulatory venous pressure of approximately 50 centimeters of saline. Further studies revealed that saphenous vein was not diseased in a significant percentage of patients. Accordingly, in 13 patients with ulceration from venous insufficiency, as confirmed by inspection and venography, the vein was divided at the knee joint and the proximal end anastomosed to the popliteal vein while the distal portion of the saphenous vein below the knee was removed down to the site of venous ulceration. This venous anastomosis between the saphenous and popliteal veins permitted an additional outflow of blood from the lower extremity and was associated postoperatively with an average decrease of 50 percent in ambulatory venous pressure in the extremity.

If confirmed in experiences with additional patients, this operation may be of significance because it offers one method of improving venous function in an extremity crippled by thrombophlebitis and venous insufficiency. Considerable care will be required, however, to be certain that the saphenous vein is free of disease with competent valves because the use of an incompetent saphenous vein will simply intensify the venous insufficiency already present.

MEDICAL ABSTRACTS

PLAGUE IN VIETNAM 1965–1966

J. D. Marshall, Jr., R. J. T. Joy, N. V. Ai, D. V. Quy, J. L. Stockard, and F. L. Gibson, Amer J Epidem 86(3):603–616, Nov 1967.

Plague continues to be a significant public health problem in the Republic of Vietnam. During 1965, a total of at least 4,503 cases occurred. In the first six months of 1966, an additional 2,649 cases have been reported. The dramatic increase in number of cases reported in 1965–1966 as compared to the preceding four years is due in large part to a better reporting system initiated in 1965.

The extension of the epidemic to the five northern provinces appears to be related to the transportation of grain from established foci.

No antibiotic resistance for streptomycin, chloromycetin or the tetracyclines was noted in the 412 *Pasteurella pestis* strains isolated from humans during the last half of 1965 and the first six months of 1966. A single strain, isolated from a *Rattus norvegicus*, was resistant to 25 mcg of streptomycin.

PHARMACOLOGIC ASSISTANCE TO THE FAILING CIRCULATION

R. H. Clauss, MD FACS, and J. F. Ray III, MD, Surg Gynec Obstet 126(3):611–631, Mar 1968.

A description of pathophysiologic vasoconstriction in acute pulmonary edema, decompensated heart failure, shock of hemorrhagic, myocardial, and gram-negative septic origin, or low cardiac output syndrome after cardiopulmonary bypass is presented.

Constriction of resistance and capacitance vessels exerts a beneficial homeostatic effect during sublethal hemorrhage, injury, and disease, but causes deleterious effects in a variety of cardiovascular catastrophes. In these states the shift of blood volume from systemic to pulmonary vascular beds causes central circulatory congestion, adversely affecting gas exchange and ventricular function. Modification of vasoconstriction and its effects with drugs which stimulate beta adrenergic receptor sites or block alpha adrenergic constricting mechanisms is advocated for its demonstrated benefit. The importance of fluid therapy in all varieties of shock is stressed. The merits of close monitoring of essential physiologic parameters by a physician are cited.

FAT EMBOLISM IN BATTLE CASUALTIES

LT C. T. Cloutier, MC USN, LT B. D. Lowery, MC USNR, LCDR T. G. Strickland, MC USN, LT L. P. Dehner, MC USNR, and LCDR L. C. Carey, MC USNR.

Fat embolism has been incriminated as a possible major contributor to the pulmonary problems seen in patients with severe extrathoracic wounds. Fifty severely wounded patients have been evaluated for systemic fat embolism. Careful clinical observations were correlated serially with qualitative urinary fat, serum lipase, chest radiographs, electrocardiograms and arterial blood gases. All patients were followed a minimum of 4 days or until death.

All fifty patients were suffering from overt hemorrhagic shock on admission. Twenty had traumatic amputation of one or more extremities; eighteen others had long-bone fractures and the remainder had only soft-tissue wounds. Those without skeletal injury had a lower incidence of fat in the urine. Forty-three of fifty patients had fat in their urine at some time during their first 4 days of hospitalization. In twenty-seven of these, 3 or more different samples contained fat. Twenty-nine had serum lipase levels above 2 Cherry-Crandall units during their period of study. No lipase elevations were observed in the absence of urinary fat.

While all patients had lowered arterial pO_2 levels, often marked, during their hospital course, no correlation could be drawn between fat in the urine, serum lipase levels and arterial pO_2. Only 2 of the patients developed clinical evidence of fat embolism. Both had severe, progressive pulmonary insufficiency, cerebral dysfunction and peculiar, abrupt anuria after apparently adequate renal function. Both expired and are discussed in detail.

(From: The Naval Medical Research Institute, Experimental Surgery Division, National Naval Medical Center, Bethesda, Maryland, 20014, The Station Hospital, U.S. Naval Support Activity, DaNang, Republic of Vietnam, and the Naval Medical Research Unit–II, Taipei, Taiwan.)

BLOOD GAS DETERMINATIONS IN THE SEVERELY WOUNDED IN HEMORRHAGIC SHOCK

LT B. D. Lowery, MC USNR, LT C. T. Cloutier, MC USN, and LCDR L. C. Carey, MC USNR.

Previous investigators have suggested that extrathoracic close-range blast injuries and high velocity gunshot wounds may result in depression of arterial pO_2.

Forty-two seriously wounded young males have been studied. None had thoracic or intracranial injury.

Arterial pO_2 and pCO_2 were determined on admission, immediately postoperatively, every 6 hours for four periods, and then daily for three days.

Arterial pO_2 averaged 90 mm Hg on admission, dropped to a mean low of 72 mm Hg at the end of twelve hours post surgery, and reached 80 mm Hg by the third postoperative day.

In twenty patients, pO_2 below 60 mm Hg was reached at some time in the first 4 days of hospitalization, usually within the first twenty-four hours. Thirteen of these had either severe blast wounds with traumatic amputation of one or more extremities or high velocity gunshot wounds. An equal number of patients with similar injuries, however, had no depression in pO_2 levels. Arterial pCO_2 levels were normal in all patients at the time when pO_2 levels were low. This, coupled with little response in pO_2 to oxygen administration, supports shunting as a cause of the low oxygen partial pressures.

Three of the forty-two patients died during the four day study period, two of fat embolism and one of renal failure. In two of the three, respiratory function was improving at the time of death. From these dates, no correlation could be drawn between the mechanism of wounding and arterial pO_2 depression.

(From: The Naval Medical Research Institute, Experimental Surgery Division, National Naval Medical Center, Bethesda, Maryland, 20014, The Station Hospital, U.S. Naval Support Activity, DaNang, Republic of Vietnam, and the Naval Medical Research Unit–II, Taipei, Taiwan.)

DENTAL SECTION

MIXED TUMORS OF MINOR SALIVARY GLANDS

Norman E. Wright, Amarillo, Texas, Southern Med J 60(3):263–268, Mar 1967.

Mixed tumors are the most common lesions of minor salivary glands. They are usually asymptomatic, slow growing, non-ulcerated growths of the palate, oropharynx, lips, tongue, check or nasal cavity. Although these tumors grossly and histologically appear to be encapsulated, closer observation reveals this to be a false or pseudo-capsule with numerous extensions of the tumor beyond the capsule. Capsular dissection of this tumor, therefore, should be condemned and an adequate margin of normal tissue removed to insure complete removal. Six cases are presented in which mixed tumors of the palate and oropharynx were removed with what was considered to be an adequate margin of normal tissue. Although adherence to this principle resulted in serious anatomic impairment in three of these cases in which the tumors were quite large, there has, to date, been no evidence of recurrence. Symptoms of serious otitis in two of these cases and intermittent epistaxis in one other were a most unusual finding.

(Abstracted by: CAPT George H. Green, DC USN.)

REAMERS VERSUS FILES IN PREPARING ROOT CANALS

CDR R. A. Vessey, DC USN.

Work has been completed by CDR Vessey, Naval Dental School, National Naval Medical Center, Bethesda, Maryland, on the effects of reaming versus filing on the shape of root canals.

The most common cause of endodontic failure is incomplete obliteration of the root canal, *especially in the apical 5 mm.* Success therefore depends on an "ideal" preparation; that is, one that is smooth,

tapering, and round in cross section to permit close conformation of the master cone used in canal obliteration. There is some question as to whether the various instrumentation techniques used within the dental profession all achieve the desired result. To answer this question, preparations were made in the root canals of thirty-three extracted mandibular central and lateral incisors; then cross sections were measured mesiodistally and buccolingually to determine whether (1) different techniques of using files and reamers produced differences in intracanal preparations, and (2) files produced the same type of preparation when used with a reaming action as when used with a filing action. The ratio of buccolingual to mesiodistal dimensions was computed because excessive enlargement of the canal, when it occurred, was in the buccolingual dimension. The ratio for reamers was 1.0, for files used with a reaming action, 1.04, and for files used with a filing action, 1.26. This work has been reported in detail in Naval Dental School—TR–001, 15 January 1968. The project was accomplished and supported through funds provided by the Bureau of Medicine and Surgery.

(Abstracted by: CDR R. A. Vessey, DC USN.)

SIALOGRAPHY: A USEFUL AID IN DIAGNOSING PAROTID TUMORS

Richard T. Carlin and Reubin Soldin, Brooklyn, New York, J Oral Surg 25(2):139–146, Mar 1967.

Two technics of sialography are described and several cases of benign and malignant parotid tumors are presented to illustrate some of the advantages and disadvantages of sialography. Although the sialogram cannot provide a definitive diagnosis, it may help to formulate a reasonable differential diagnosis and to distinguish between surgical and nonsurgical cases by delineating the size and location of the lesion.

(Abstracted by: CAPT George H. Green, DC USN.)

PERSONNEL AND PROFESSIONAL NOTES

NAVAL DENTAL SCHOOL

An outstanding event of the National Children's Dental Health Week Program at the Naval Dental School was the opening of a new Preventive Dentistry Clinic. This clinic had been planned for some time, but spaces and equipment were not available until last December; therefore, the work of redecorating the spaces and installing equipment had to be expedited so that the opening date could coincide with the advent of National Children's Dental Health Week. The new clinic spaces include a reception room; a viewing room for dental health education by means of visual aids such as color motion pictures, filmstrips, and slides; a brushing room where six patients at a time can perform the self-preparation phase of the Navy's three-agent stannous fluoride cariostatic treatment; and a treatment room with two dental chairs. Six patients are appointed for each 1-hour cycle, which consists of a dental examination; use of a prophylactic kit furnished each patient for the self-preparation phase of the cariostatic treatment, a topical application of stannous fluoride, and dental health education. Except for the dental examination and topical application phases of the cycle, the patients form a small class in the viewing section so that all have an opportunity to view the entire series of visual aids to oral health. Although the new clinic is primarily for military personnel, the first week of operation was devoted to military dependents between the ages of 6 and 23, and the program for dependent children will be continued during a few hours each week throughout the year.

A new idea incorporated in the program this year was a "Dental Careers Day" for members of Medical and Para-Medical Clubs at four Montgomery County high schools. Plans included bringing some 70 students to the Naval Dental School, where they would view a narrated and illustrated slide presentation on each of the dental specialties, followed by table clinics in each specialty. Each student would be given an opportunity to discuss his own ambitions with naval dental officers, oral hygienists, and dental assistants.

Twenty-three naval dental officers, both staff officers and graduate students, had made arrange-

ments to provide dental health education to students in various schools in the County. In general, the programs consisted of showing motion pictures on dental health, the use of flip charts prepared at the Dental School, and demonstrations on models.

In the Naval Hospital, the Education Specialist in Preventive Dentistry provided an entertaining and instructive program on dental health for children on the pediatrics wards, and videotape recordings on dental health were shown throughout the week in the pediatric walk-in clinic. The Preventive Dentistry Officer talked to the mothers in the maternity wards about the importance of diet to the developing teeth and the need for preventive care of the deciduous dentition.

On Saturday, February 10, RADM F. M. Kyes, Assistant Chief of the Bureau of Medicine and Surgery (Dentistry) and Chief, Dental Division, and other staff officers of the Dental Division used the clinical facilities of the Dental School to provide preventive dentistry treatments for children of military personnel assigned to the Bureau of Medicine and Surgery.

IDENTIFICATION LIST FEDERAL SUPPLY CATALOG

Activities are reminded that all dental items are not necessarily listed in Class 6520 of the Federal Supply Catalog. A listing of FSC Classes which include dental items is located on page 2 of the Federal Supply Catalog Class 6520 Identification List. For example, some activities have been procuring, by open purchase, a plastic coated disposable dental towel, unaware that this item is available in the Federal Supply Catalog. Complete identification is:

Index No.	*FSC No.*	
3290	*8540*–082–6606	
Descriptive Data		*Price*
Towel, Paper, Plastic Coated on one side, Disposable, Dental 100's		$1.50 pg.

NAVAL DENTAL OFFICERS HOLD OFFICES IN AMERICAN ASSOCIATION OF ENDODONTISTS

Naval Dental School, NNMC, Bethesda, Md.—During the recent meeting of the American Association of Endodontists, CAPT W. G. Hedman, Jr., DC USN, former Vice President of the Association, was installed as President Elect, and CAPT J. F. Bucher, DC USN, former Secretary-Treasurer, assumed the office of Vice President. The 25th Anniversary Meeting of the Association was attended by fifteen active duty naval dental officers.

NURSE CORPS SECTION

NURSES UNDER THE SEA—PART II

LT Patricia Fellenz, NC USN.

Hyperbaric oxygenation represents an abnormal physiologic state. The concentration of O_2 involved imposes pharmacologic effects which may oppose desired benefits. Thus the problem of oxygen toxicity must be considered in all cases being subjected to hyperbaric oxygenation. Oxygen at increased pressures causes a change in cerebral cortical blood flow. Present data indicates that vasoconstriction occurs at 2 ATA after about 30-40 minutes. When O_2 is at 3 ATA, there is an initial increase in cerebral blood flow with a fall in values toward normal air control blood flow rates. Vasoconstriction does not occur with O_2 at 3 ATA.

For a very long time gas gangrene and other Clostridial infections have been among the most dreaded complication of wounds of violence because of their rapid and lethal course. The use of oxygen in such cases is obviously based on the anaerobic nature of the organism. By increasing the amount of O_2 in the tissues and the plasma, dramatic improvement has been demonstrated. At present the total number of treated cases of tetanus is small and in most the therapeutic effect of hyperbaric oxygen is masked by conventional therapy. In the case of Botulism it is widely accepted that the causative organism cannot multiply in the human body and

the disease results from absorption of preformed toxin in the contaminated food. Because the effect of HBO is on the organism and not on the liberated toxin, chamber therapy is not indicated in such cases.

Other specialties of medicine are engaged in the use of hyperbaric medicine. For example, radiotherapists have been using HBO in the radio therapy of cancer. Surgical correction of cardiovascular anomalies in children has been attempted with gratifying results using hyperbaric oxygenation. Peripheral vascular impairment following vascular injuries has been alleviated in pressure chambers. However the hyaline membrane disease of children has not been aided by HBO as the respiratory acidosis is not resolved and it is suspected that the use of HBO is actually detrimental.

Carbon monoxide poisoning is the second most frequent cause of poisoning deaths. It is generally held that the most important factor in the treatment of carbon monoxide poisoning is the correction of tissue anoxia. By ridding the blood of carbon monoxide the hyperbaric chamber becomes a therapeutic tool for the restoration of O_2 to the tissues. This is done by bypassing the converted carboxyhemoglobin and transporting the O_2 directly dissolved in the plasma.

The nursing care of patients in a hyperbaric chamber is basically the same as it would be in any hospital situation. When a patient is placed in the chamber for any treatment other than surgical, his routine medications and treatments are continued as if he were in his own unit. Since this tends to be a rather frightening situation for the patient, it is very important to give him constant reassurance. One of the most stabilizing factors is when he discovers that he will not be alone in the chamber. A nurse is always in attendance. If the patient is unconscious or to undergo anesthesia while in the chamber a myringotomy is routinely performed, because he will be unable to equalize the pressure in his ears by himself.

The hazards of elevated barometric pressure are varied. Barotrauma is the general term given to body injuries sustained when exposed to high pressure. When the pressure is elevated on the outside of a body cavity, a partial vacuum occurs. If the pressure is not equalized a "squeeze" occurs. Included in this group are ear squeeze, sinus squeeze, lung squeeze, aerodontalgia or pain in a tooth from a cavity, and skin squeeze. All of these are characterized by pain, the degree of which depends on the amount of pressure.

Nitrogen narcosis is comparable to all states of anesthesia. The symptoms are subtle and can lead to death if not detected and corrected. These include poor performance similar to alcohol intoxication, confusion, and impaired judgment. This can be avoided by using helium in place of nitrogen in the gas mixture.

Oxygen toxicity is caused by elevated O_2 concentration for prolonged periods of time affecting the central nervous system. Symptoms to observe are nausea, vomiting, muscle twitching, and in severe cases grand mal seizures. If any of these occur the O_2 should be discontinued immediately.

Decompression sickness is the term given to the ill effects that can be experienced in individuals who, after breathing air for an extended period of time, decompress too rapidly to allow for the gradual elimination of excess nitrogen in the tissues. This is commonly known as "The Bends". The rate of nitrogen elimination is circulation-limited. Rapid return to sea level pressure leaves a high partial pressure of nitrogen in a tissue and nitrogen will escape from solution in the tissue fluids forming bubbles. The distortion of tissue and the ischemia produced by the bubbles cause itching, pain, dyspnea, or paralysis, depending on whether the bubbles form in the skin, joints, lungs, or central nervous system. Since excess oxygen in the blood is metabolized during one circulation through a tissue, oxygen itself does not produce bends. As pointed out before, if bends due to nitrogen occur in the course of hyperbaric therapy, the most effective treatment is administration of oxygen at increased pressure.

Air embolism is the most disastrous result of pulmonary over pressurization caused by the dissection of alveolar gas into the pulmonary venous system. The gas is carried to the left heart and then into the systemic circulation, resulting in gas emboli in the coronary and cerebral circulation. Gas bubbles continue to expand with further decrease of pressure increasing the severity of clinical symptoms.

The untoward effects of CO_2 intoxication result from abnormal accumulation of CO_2 in the body, usually caused by inefficient or insufficient ventilation or voluntary breath holding. Symptoms produced are double breathing, shortness of breath, and distress leading to unconsciousness and death. The general rule is to ventilate one minute of every five if on air and two minutes of every five if on O_2.

It is necessary to sound a strong note of warning that the use of pressure therapy with oxygen is potentially dangerous to patient, physician and nurse alike. However, these hazards are subject to logical appraisal in advance and can largely be prevented by awareness and appropriate training of personnel involved. Considerable optimism is expressed that the use of high oxygen pressures will find a rational and lasting place in therapy. If this prediction is borne out, it will be the result of meticulous exploration of the basic effects of high oxygen pressures in normal and pathological states and carefully controlled clinical trials.

At the present time the Navy is involved in training of submarine personnel, recompression when needed, and medical research. Some work has been done in Vietnam with cases of gas gangrene with a great deal of success. The first classes for the training of Navy nurses in hyperbaric work were held at the Submarine Medical Center, New London, Connecticut last spring. At that time four nurses underwent training in the basic theory, gas laws, and actual handling of the chamber itself. It is hoped that this course will be improved and expanded in the future and that Navy nurses may not only go to sea, but serve under the sea.

SUBMARINE MEDICINE SECTION

SEALAB III—DIVERS DIVE PAST ONE THOUSAND FEET

CDR Robert Bornman, MC USN.

In ceremonies at the Pentagon on 5 March 1968 Admiral Thomas Moorer, Chief of Naval Operations, decorated six Navy Aquanauts of the Deep Submergence Systems Project Technical Office (DSSPTO), San Diego, for executing a record-breaking deep dive the previous week. Five of these Aquanauts had made a 48 hour "saturation" dive at a depth of 825 feet and two of the team had made a deeper short "excursion" to 1,025 feet. This chamber dive had been carried out as part of a long range program in preparation for Operation SEALAB III next autumn and in development of the new Deep Diving System to be placed aboard the next generation of submarine rescue vessels (ASRs).

In September of 1967, personnel of the DSSPTO were transferred to the Washington Navy Yard to carry out a series of saturation dives in the pressure facilities of the Experimental Diving Unit (EDU). When the series is completed at the end of April twenty divers will have made saturation dives to 600 feet and 32 others will have been saturated at 450 feet. In addition, 28 no-decompression excursions will have been made 150 feet deeper from the saturated condition at 450 or 600 feet. These totals are in addition to the deepest dives made by the five divers who went to 825 feet.

A significant amount of medical investigation of the human diver at these great depths had been conducted during this period by the three submarine medical officers of the DSSPTO: CDR Paul G. Linaweaver, LCDR James Vorosmarti, and LCDR Mark E. Bradley, with the cooperation and assistance of Medical Department officers from EDU and the Naval Medical Research Institute (NMRI).

A great bulk of the work done has been to document in a variety of detail that humans exposed to pressure changes of this magnitude still preserve the homeostasis of ordered physiologic function. Other determinations have been part of the medical input necessary to design and develop engineering systems to preserve an external milieu favorable to human existence without disorder, whether the diver is in the "shirt sleeve" environment of the pressurized habitat or is rigged in diving apparatus and swimming or working out in the water.

Divers within the chambers at EDU and within the SEALAB habitat breathe an artificial atmosphere in which the inert gas is continuously recirculated while carbon dioxide is removed by chemical absorbents and additional oxygen is added to replace that lost through metabolic consumption. The partial pressure of oxygen is controlled at 0.3 atmospheres absolute, or about 50% higher than the tension in air at sea level. No deleterious effect of maintaining the oxygen at this level has occurred in any of the measurements made during

this program of dives. Blood samples have been drawn regularly for routine hematologic counts and standard clinical serum evaluations. Studies of bleeding and coagulation have been normal. The search for more subtle indications of stress has included determination of the divers' lactic acid dehydrogenase, phospholipids, lipoproteins, neutral lipids, and haptoglobins. All have fallen within normal limits.

The Naval Research Laboratory (NRL) of Washington has been requested to advise the SEALAB operation in respect to identification and control of toxic contaminants in the synthetic atmosphere of the habitat. Although it is planned to put the 40 Aquanauts down in teams of 8 for five periods of 12 days each, the atmosphere will be essentially the same throughout the entire 60 days of submerged operation. At 600 feet the proportion of major gases used will be 1.6% oxygen, 6.0% nitrogen and 92.4% helium. At a total pressure of 282 pounds per square inch absolute (psia) the physiologic effect of a trace contaminant theoretically will be 19.2 times that of an equal fraction of the same component at sea level pressure or 14.7 psia. During the dives at EDU gas samples have been withdrawn regularly for spectrographic analysis at NRL. The concentrations of significant contaminants have been plotted to determine likely growth rates during similar but more prolonged exposures. Such information is vital to set specifications in the design of equipment to remove or destroy troublesome contaminants.

In a parallel study samples of the divers' blood have been analyzed at NMRI for the level of carbon monoxide (CO) and compared with the atmospheric concentration of CO at that time as determined by the NRL study. Since there is no smoking permitted inside the chambers both smokers and non-smokers alike soon equilibrate to the level of atmospheric concentration of CO, which during these dives has been lower than that normally seen in the smokers of the group. A certain small amount of CO is continuously produced within the body by the normal degradation of hemoglobin. In a closed atmosphere over a period of time this will build up to a significant level. The results of these present CO studies have shown that in the dynamic competition of oxygen and carbon dioxide for binding with hemoglobin the equilibrium constant of the reaction is independent both of the total pressure and of the nature of the inert gases present. The 50% increase in oxygen partial pressure works during these dives, as it would at sea level pressure, to move the equilibrium in favor of the oxygen. However, with the same fractional concentration of CO, the partial pressure and the toxic effect of this gas is multiplied 19.2 times in the 19.2 atmospheres pressure of 600 feet. The nature of the problem for SEALAB is to develop equipment which must be 20 times more efficient despite a possible constraint on energy input and catalytic bed temperature for a sea-floor operation. It is also necessary to develop analytical instruments capable of operating under great pressures with similarly increased accuracy and discrimination.

It is the pulmonary system that has to date marked the chief difference between men and fishes, and it is the diver's pulmonary system that must be most closely wedded to his diving equipment. Control of the oxygen pressure, removal of carbon dioxide, and substitution of helium for the denser nitrogen of air have eliminated some earlier obstacles to deep diving, but a price must still be paid in ventilatory efficiency if man breathes gas at increasing depths. A great number of measurements of the tidal volume, vital capacity, forced expiratory volume, maximum breathing capacity, dynamic compliance and volume flow loops of the Aquanauts' breathing chamber gas have been made through the range of pressures encountered down to 825 feet, and a number of additional studies with a breathing mixture of neon-oxygen have also been done at 600 and 825 feet. On one dive a bicycle ergometer was mounted inside the chamber and exercise tolerance studies performed at increments of 150 feet down to 600 feet. Analysis of the results of these studies are now in progress, but the results to date as well as the successful dive to one thousand feet prove that man can go deeper, and that the limitation of ventilatory reserve is not yet a critical problem.

The Microbiology Division of NMRI has undertaken a study to determine what changes in bacteriological flora take place when human beings are crowded together in a small chamber pressurized to great depth with helium. Smears have been taken on representative dives from the ears, throat, nose and groin of the divers and from the chamber bulkheads and from the chamber atmosphere. Similar studies will be made during the at-sea operation to determine if the ocean bottom location has any additional effect. The Stress Physiology Division of NMRI is working also to develop thermal protective suits to keep the Aquanauts warm during the diving operations in the chill waters near the ocean floor.

In addition to providing supplementary medical coverage during the dives the Medical Department

staff of EDU under LT James K. Summitt have participated whole-heartedly in individual research and investigations. Provision of instruments for analysis and control of the levels of important metabolic gases in the chamber environment has been their responsibility. An EDU measurement of factors determining visual performance of divers at 600 and 825 feet showed that acuity is not affected by pressure per se, although the physical factors of field limitation, refraction, turbidity and available light do make vision an important problem of diver performance. The SEALAB saturation dives have been utilized for another long term EDU study of human engineering factors in diving. It is interesting that in measurement of motor performance of divers in a dry environment and in the water at increasing depths, the decrement in both gross and fine motor performance is approximately the same in going from very shallow to 600 feet depth as that seen when the diver was changed from a dry to a wet environment at about the same pressure. A tremendous increase in work efficiency should be possible if the tasks required of the diver and the tools developed to accomplish these tasks are analyzed in terms of the physical restrictions of the underwater environment. Another EDU psychology project is to study the changes in associative memory with increasing depth.

Captain George F. Bond, Assistant for Medical Effects for the Deep Submergence Systems Project and Principal Investigator for the SEALAB Operation, has over-all responsibility for the bio-medical research program for SEALAB III. Several years ago Captain Bond, Captain Workman, and Captain Mazzone conceived the idea and began the modest experiments that have a decade later become the large SEALAB III organization.

AEROSPACE MEDICINE SECTION

MASS CASUALTY HANDLING ABOARD CARRIER—PART IV

Report of the Management of Casualties Aboard an Attack Aircraft Carrier (CVA) by CAPT Jefferson W. Paslay, MC USN, Senior Medical Officer; LCDR James B. Green, Jr., MC USNR, General Surgeon; LT E. W. Hunt, MC USN, Flight Surgeon; and LT J. B. Lench, MC USNR, Flight Surgeon.

On the night of 25 October, the forward magazine crew on the forward mess deck was loading Zuni rockets into a "LAU"–10 launcher when the crew leader applied power with a hand tester to a supposedly empty launcher. Four rockets were installed in the launcher, one of which ignited and traveled twenty feet across the compartment, imbedding the mark 24 warhead in a steel bulkhead. The warhead did not detonate and was later safely removed. The crew leader was being assisted by seven other men, and there was also another man in the after portion of the compartment taking fuel tank soundings via a receptacle located there. The rocket motor for a Zuni burns for only 2.5 seconds, but the intense heat generated set the port bulkhead and overhead on fire, burning all men working in the compartment.

The fire began at 2157, the fire alarm was sounded at 2159, and general quarters was ordered at 2205. Men from "G" division responded quickly, extinguishing the fire within 3 to 4 minutes. Two of the burned victims walked to sick bay before general quarters was sounded, and the other seven injured men were transported in Stokes stretchers, as the men in "G" division performed as they had been taught in mass casualty exercises.

Air blowers in the #2 engine room failed, resulting in an overheated compartment with temperatures estimated at 200° F. As a result of the extremely hot temperatures, sixteen cases of heat exhaustion resulted. There were also an estimated fifty cases of smoke inhalation among the crew fighting the fire and removing ordnance. Casualties from the fire included nine men with second and third degree burns covering from 15% to 84% of their body surface. Because of the extent of injury, all of these victims were promptly brought to sick bay for evaluation and treatment. The sixteen heat exhaustion victims and the estimated fifty men suffering from smoke inhalation were brought to the after mess deck which serves as a casualty collecting area. This arrangement was elected to prevent congestion and confusion in sick bay where the burn victims were receiving intensive treatment.

Upon arriving in sick bay, the senior medical officer, and the general surgeon were met by the first casualties of the fire and more were to arrive soon thereafter. The two flight surgeons were already in sick bay treating the first casualties before general quarters was sounded.

As the other medical officers were administering emergency treatment to the first casualties, the surgeon circulated among the patients and quickly estimated the extent and number of injuries. After completing the process of triage, it was determined that there were nine seriously burned men, three of whom were considered critical. A medical officer and assisting corpsmen were assigned to the care of the four most seriously injured patients while dental officers, corpsmen, and dental technicians were assigned to the treatment of the remaining casualties.

Treatment

What clothing remained on the burn victims was removed and the body surface area burned was estimated according to the "Rule of Nines". Although this method is not as accurate as the Lund and Browder chart, it was considered easier for the corpsmen to remember and employ in time of mass casualties.

All casualties with 20% or more of the body surface area burned were immediately cannulated with a 16 gauge angiocath. In two instances, the angiocaths were unsatisfactory, requiring the surgeon to perform a venous cutdown in order to establish a satisfactory means of administering replacement fluids. In all cases, the fluid therapy consisted mainly of lactated Ringer's solution as advocated by Moyer et al. Morphine was administered intravenously and intramuscularly for relief of pain, which, in many cases, was extreme. Foley indwelling catheters were inserted in the bladders of patients with 50% of their body burned or if the genitalia was involved by the burn. This made possible the measurement of hourly urinary output which served as a guide in determining I. V. fluid requirements. The burns were then cleansed with Phisohex[R] and surgically debrided as deemed necessary, employing aseptic technique.

After completion of debridement, the wounds were dressed with Furacin[R] (Nitrofurazone ointment), sterile 4X4 gauze pads, and sterile Kerlix[R] bandage.

As the dressings were completed, each patient was administered 0.5 cc tetanus toxoid intramuscularly. All nine victims incurred burns to the face, requiring close observation for respiratory distress. It was elected to perform a tracheotomy on one of the patients, and this was quickly accomplished under local infiltration anesthesia. Neosporin[R] ophthalmic ointment was placed in the eyes of all patients, and one patient was thought to have corneal burns.

Several of the patients presented with simple lacerations which were cleaned, debrided, and repaired. One patient had an open comminuted fracture of the 1st metacarpal in the left hand which was irrigated, debrided, and closed in the operating room under brachial block anesthesia.

As mentioned earlier, lactated Ringer's solution was administered intravenously to those patients needing replacement fluid therapy, however, some victims were also given one or two units of human albumin intravenously. Under this management, all patients remained altert with stable vital signs, and no blood was administered.

The heat exhaustion cases were allowed to rest and ice packs were applied. They were provided with water and NaCl tablets by the corpsmen and dental technicians.

The smoke inhalation cases were administered oxygen via face mask and encouraged to cough. The flight surgeon with anesthesia training supervised the treatment of the casualties by the corpsmen. These patients promptly responded to the treatment and no complications resulted.

Evacuation

By the time the above described treatment had been completed, a C2A aircraft, which had been requested after evaluation of the casualties by the surgeon, landed on deck to provide air evacuation to Clark AFB Hospital. The C2A is a two engined turboprop aircraft which can quickly be fitted to carry six litters in bracket fittings. However, the airplane can carry a total of 24 passengers and cruise between 250 and 260 knots. By securing Stokes stretchers to the deck of C2A, all nine burn victims were accommodated in the aircraft. Three hospital corpsmen and a flight surgeon accompanied the nine casualties providing further supportative care. A typewritten report describing the extent and type of injury plus the treatment administered, accompanied each patient. The casualties left the ship within seven hours after the accident. After being further evaluated at Clark AFB Hospital, the six most seriously burned patients were air evacuated to the 106th Army General Hospital at

Yokohama, Japan, while the three other patients were transferred to the Naval Hospital at Yokosuka, Japan.

Discussion

Fortunately, mass casualty management, including the care of burns, had been covered early in the annual lecture series for hospital corpsmen. The dental officers and technicians had also attended these lectures prepared by the surgeon. No doubt this was largely responsible for the efficiency and promptness exercised in the handling of the casualties, since many of the personnel had never been involved in the care of a seriously burned patient prior to this incident.

According to recent surgical literature, the treatment of burns with Furacin^{R} ointment is considered inferior to the use of either 0.5% continuous AgNO3 dressing or 10% Sulfamylon^{R} cream, 4-Aminomethylbenzene sulfonamide. Unfortunately, the ship's medical laboratory does not possess facilities for performing serum electrolyte determinations, therefore, it had been predetermined unwise to employ AgNO3 in the treatment of burns because of the electrolyte changes involved. Sulfamylon^{R} is not available, and it produces hyperchloremia and acidosis again making necessary, testing of CO_2 combining power and serum chloride, studies not available aboard ship.

Unfortunately, three of the victims expired several days later as a result of their burns, and at last report, another had been air evacuated to Brooke Army Hospital, where his condition was critical. Nevertheless, the loss of life could have been far worse if it had not been for prompt treatment aboard ship. Again, planning ahead, namely lectures for the medical and dental staff, prevented a worse tragedy. A surgical team in a major hospital is often completely occupied treating one seriously burned victim, therefore, the manner in which the staff responded to the care of the nine casualties was very gratifying.

Recommendations

In retrospect, one should be able to recommend improvements for the care of victims in any future incidents, and this experience is no exception. Although abundant supplies of lactated Ringer's solution had been stocked with care, other needed supplies were exhausted by the treatment of the nine patients. The Furacin^{R} ointment was depleted by the time the last dressing was applied. Past personal experience indicates that 0.5% AgNO3 solution is every bit as good in the treatment of burns as claimed by Moyer et al. If facilities to determine serum electrolytes are available, then the use of 0.5% AgNO3 solution would be preferred to the use of Furacin^{R}. The solution is inexpensive, easily prepared, and can be employed satisfactorily by corpsmen in event of mass casualties, according to the technique recommended by Moyer et al. If Sulfamylon^{R} could be obtained, it might even prove to be better for use on an aircraft carrier than AgNO3.

Furthermore, it would have been better to have monitored the central venous pressure in the patients receiving I. V. fluid therapy. Time didn't allow this under the circumstances. The department has recently requested supplies of central venous pressure catheter and monometer sets (Fenwall Lab #HB–12), finely calibrated and valved urine collection chambers (Doval urimeter #3580), and Foley catheterization sets (Bardexpax #8464).

Planning ahead, particularly the establishment of lectures to instruct the medical and dental staff in the practice of mass casualty management, physical diagnosis of injuries, triage, and emergency surgical treatment can not be over emphasized.

The training provided by the use of the surgical operating facilities and surgical team for frequent elective procedures proved to be of value in this emergency as it has been in others. An efficient skilled surgical team can only be developed by frequent and repetitive experience.

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AVIATOR'S SPEECH DISCRIMINATION TEST DEVELOPMENT

LT R. P. Whitten, MSC USNR
and James W. Greene.

In the past, the Bureau of Medicine and Surgery had to rely primarily on pure tone audiometry to determine whether or not aviators experiencing hearing loss could continue to fly. Although pure tone audiometry is widely used to detect and help diagnose hearing loss, it does not present the entire picture of one's hearing ability. Pure tone tests are used primarily to determine air-conduction and bone-conduction thresholds of hearing. Another

type of audiometry—speech audiometry—is used principally to obtain speech reception thresholds and speech discrimination scores for diagnostic purposes. The need for speech audiometry arises because speech is by far the most important class of sounds we wish to hear.

The speech discrimination ability of the pilot, then, is really what we are trying to determine with audiometry; to accomplish this a test was devised in 1964 by the Naval Aerospace Medical Institute. This test is known as the Naval Aviator's Speech Discrimination Test (NASDT). It is not used in lieu of pure tone audiometry, but in support of it. A pilot failing to meet MANMED requirements of pure tone audiometry shall take the NASDT; the results can be used to assist the Flight Surgeon in deciding whether or not a waiver for hearing is in order.

The NASDT was designed to determine the aviator's ability to understand speech signals in a background of aircraft noise. It provides the Bureau of Medicine and Surgery with a means of evaluating the aviator's speech discrimination in terms of the operational environment as opposed to the application of a fixed standard of physical fitness. Although many aviators may exhibit a high frequency hearing loss, one does not find a consistent relationship between his ability to understand speech at high levels in a noise background and the configuration of the pure tone threshold audiogram currently used in hearing acuity evaluation.

The NASDT test signals are a list of 100 one-syllable words mixed with background noise of a UC–45J in normal cruise. The word lists currently used are phonetically balanced (PB) words taken from disc recordings originally produced by the Central Institute for the Deaf (St. Louis, Mo.) as Auditory Test W–22. Due to the particular vowel-to-consonant ratio of speech signals on the voice recording and the aircraft noise spectrum, a signal-to-noise ratio of +15 dB was established as the desired relationship. That is, speech peaks were set at 15 dB above the background noise level. This ratio was monitored during the recording and copying process on a Brüel and Kjaer Model 2305 Level Recorder which gives the root mean square value of noise level relative to the speech peaks.

The two NASDT systems currently being used by the Navy are:

1. The Revere M–3 System which is a tape cartridge player that automatically handles the cartridge. It features a pair of ear phones matched within 2 dB. Copies of master tape are recorded on a Revere M–2 Tape Cartridge Recorder. The volume control is locked at a predesignated level.

2. Cousino AR–7328 System is an audio repeater Revere/tape cartridge player. It is simpler than the R–M–3 and provides an endless loop-type tape cartridge. A foil sensing strip at the end of the test recording automatically shuts the machine off. Its volume control is also locked.

Each system was calibrated with its own headset and tapes. A Brüel and Kjaer Model 2203 Sound Level Meter, used with a standard earphone coupler, was set to the "fast" meter speed and the "c" weighing response. The earphone was placed over the coupler, and the volume control of the tape player was adjusted so that the background noise averaged 100 dB Sound Pressure Level (SPL) and the speech peaks, approximately 115 dB SPL. Because the PB words have different acoustical levels for the vowel sounds, the speech peaks actually varied from 105 dB to 118 dB SPL.

Administration of the test is relatively simple and straightforward. If an aviator fails to meet minimum hearing standards, as described in the Manual of the Medical Department, he should be given the NASDT form 1A2A.

A list of the correct responses to each of two forms (1A2A and 1B2B) of the test is provided with each machine. Each word counts one percentage point. In order for a response to be graded as O.K., the exact sound of the word must be written. Incorrect spelling will not be cause for marking a response incorrect if the sounds are properly presented; i.e., "sea", "see" and "c" are acceptable, but the plural "seas" is incorrect. A score of 70% or better is a passing grade, and a waiver request should be sent to the Bureau of Medicine and Surgery. If the aviator fails to score 70% or better, he is to be retested the following day by using form 1B2B. (Note: At no time should the testee see the correct responses, either before or after the test, or to see the scoring process.) If he receives a score of 70% or better on the following day, a waiver should be requested.

Whenever the NASDT is administered, the score should be entered on the aviator's BUMED Form 88, Section 73, along with the date and place the test was taken. Under Section 74, a note is made of the loss, but indicating that the aviator passed the NASDT. (Example: Perceptive Hearing Loss; Passes NASDT (71); NCD if BUMED approves waiver.)

The NASDT form (NAVAEROSPMEDINST Form 6500/1) must be filled out completely, includ-

ing current audiometric date. This form is then folded and stapled for mailing to NAVAEROSPMEDINST. If the pure tone audiogram was performed on an automatic audiometer, the audiogram card should be stapled inside the folded NAVAEROSPMEDINST Form 6500/1 and mailed along with it.

Maintenance of the units can be handled in the same manner as for audiometer; i.e., request for information and/or maintenance should be directed to NAVAEROSPMEDINST, Pensacola, Fla. (East Coast) or Navy Missile—Center Point Mugu, Californi (West Coast).

NASDT's are located at:

NAVAEROSPMEDINST, Pensacola, Fla.
NAS, Quonset Point, R.I.
NAF, Andrews, Washington, D.C.
NAS, Norfolk, Va.
NAS, North Island, San Diego, Calif.
NAS, Imperial Beach, Calif.
MCAS, El Toro, Santa Ana, Calif.
NAS, Miramar, Calif.
NAS, Oceana, Virginia Beach, Va.
MCAS, Cherry Point, N.C.
NAS, Cecil Field, Fla.
NAS, Sanford, Fla.
NAS, Glenview, Ill.
NAS, Lemoore, Calif.
NAS, Point Mugu, Calif.
NAVMISCEN, Point Mugu, Calif.
NAS, Whidbey Island, Oak Harbor, Wash.
NAS, Barber's Point, Oahu, Hawaii

In addition to the Navy's existing NASDT, a special "aerospace" word list is being considered for the use with existing systems. The committee on Hearing, Bioacoustics and Biomechanics ("CHABA") has also, appointed Working Group 52 to study the Testing of Speech Reception of Aviators. Accordingly, the Navy might expect some modification to the NASDT in the near future. BUMED–5221 and NAVAEROSPACEMEDINST.

NAVAL FLIGHT SURGEON'S MANUAL

The publication of the *Naval Flight Surgeon's Manual* represents the culmination of a program by the Bureau of Medicine and Surgery to assemble the latest information concerning human response to the aerospace environment and to describe the occupational requirements of the job of Flight Surgeon. Naval operations within the aerospace environment are becoming ever more complex. High-performance vehicles, carrying advanced electronic systems and sophisticated weaponry, place imposing demands on operating personnel and subject both aviators and support crews to a multitude of unusual stresses. If a Flight Surgeon is to insure the well-being of aviation personnel, he must fully understand the aerospace environment and the physical and mental problems which may result from operating within this environment. Aerospace medicine has indeed become a specialized medical science.

The *Naval Flight Surgeon's Manual* reflects the efforts of many organizations and individuals. Coordination of this program was through the Office of the Assistant Chief for Aerospace Medicine, Bureau of Medicine and Surgery, and the Naval Aerospace Medical Institute. Preparation of the manual was accomplished by BioTechnology, Inc. under contract to the Physiological Psychology Branch of the Office of Naval Research. The Office of the Chief of Naval Operations sponsored the printing of the manual as a "hard-backed" permanent-type text book. Content information was provided by individuals ranging from staff officials in the Navy to medical personnel serving with the Fleet. The result of their efforts is a compilation of the latest materials concerning the practice of aerospace medicine.

The *Naval Flight Surgeon's Manual* presents information falling within three classes. The first describes the role of the Flight Surgeon as a member of operating aviation units. The second presents specific administrative procedures involved in the practice of naval aerospace medicine. The final, and most extensive, class of information describes human response to the stresses of the modern aviation and space missions. Due to its broad coverage, this manual should prove of considerable value not only to medical personnel, both military and civilian, but also to aerospace physiologists and psychologists, bioengineers, and other human factors specialists. The manual will be a principal text in the basic aerospace medicine course given at the Naval Aerospace Medical Institute and also will be the basic text for the correspondence course "Aviation Medicine Practice" conducted by the Naval Medical School.

Initial distribution of the *Naval Flight Surgeon's Manual* will be made in May 1968. Flight Surgeons, Aerospace Physiologists and Psychologists currently on active duty will receive a copy automatically. Sale to the general public through the Government Printing Office should begin by 1 July 1968 at a cost of $6.00 per copy.

MEDICAL DEPARTMENT IN THE FIRST MARINE AIRCRAFT WING: WING HISTORY

First units of the First Marine Aircraft Wing (1st MAW) to serve in Vietnam were increments of the Marine Helicopter Squadron 362. In April, 1962, this squadron provided helicopter support for Vietnamese units and conducted training programs, operating the UH–34. There were instances where light observation fixed-wing aircraft and the KC–130 aircraft for logistic flights were used in Vietnam, but it was not until April 1965 that a fighter attack aircraft, the F4B, was stationed in Vietnam. In May, 1965, these F4B's were stationed in DaNang and the Headquarters, Advanced, for the First Marine Aircraft Wing, was established at DaNang.

On June 1, 1965, the A–4 squadrons went to Chulai in Quang Tin Province and commenced operations only three weeks after construction was begun on an expeditionary airfield. Marine Air Group Twelve was the first to launch aircraft from this field on July 5, 1965.

Other elements of the Wing began to set up in Vietnam as follows:

1. August 12, 1965, elements of MAG–16 made the first Marine Corps night helicopter assault in Republic of Vietnam (South), RVN.
2. In September 1965, Ky Ha Airfield in the Chulai area was begun for MAG–36.
3. On December 19, 1965, VMFAW–312 joined MAG–11 at DaNang, RVN.
4. On May 31, 1966, elements of MWSG–17 arrived at DaNang.
5. On September 24, 1966, MAG–13 arrived in Vietnam.
6. In October 1966, the new airfield at Chulai was opened, having a ten thousand foot runway.
7. In November 1966, the A6A intruder aircraft joined MAG–11 at DaNang.
8. In January 1967, the First Marine Aircraft Wing added the world's largest helicopter to its inventory, the CH–53A.
9. In September 1967, Marine Air Control Group–18 was commissioned as a part of the First Marine Aircraft Wing.

At present, the First Marine Aircraft Wing is made up of five aircraft groups, with one headquarters group, one control group, and one service group. This Wing is the largest ever fielded by any of the services in either peace or combat environment and it is the most widely dispersed of any aircraft wing, having elements in four of the five northern provinces that make up the I Corps area in RVN. Elements of the First Marine Aircraft Wing are operating from Chulai, Marble Mountain, DaNang, PhuBai, Dong Ha, Khe Sahn, and work has commenced for an additional operating base at Quang Tri.

As these units of the First Marine Aircraft Wing came into country, they brought personnel and supply blocks for their medical components. Sick call areas and small dispensaries were established first in tents, then in hardback structures, and have progressively advanced to semi-permanent structures. As adequate facilities were established, the field equipment was augmented with garrison type equipment such as EKG machines, whirlpool baths, sterilizers, and centrifuges. Each of the five Marine Aircraft Groups has a dispensary staffed with at least four Medical Officers, and a compliment of Corpsmen sufficient to handle the clinical and medical administrative needs of the squadrons within the group. The Headquarters Group and the Service Group at DaNang each have a dispensary with two Medical Officers assigned. Both of the Light Anti-aircraft Missile Battalions, which are a part of the Air Control Groups, have a dispensary staffed with one Medical Officer. Other portions of the Air Control Groups have Hospital Corpsmen attached or receive support from a designated dispensary in their area. As of 1 January 1968, there were 31 Medical Officers, 2 Medical Service Corps Officers, and 221 Corpsmen assigned for medical support of the Wing.

DaNang and Chulai are the locations of the two primary airfields from which the fixed-wing aircraft of the 1st MAW operate. The helicopters operate from the Marble Mountain Air Facility in east DaNang, and the Chulai facilities, as well as PhuBai and Quang Tri. MAG–36 is headquartered in PhuBai, and MAG–16 is headquartered at Marble Mountain Air Facility in east DaNang.

The imagination, effort and industry on the part of the Corpsmen and Doctors have resulted in amazing improvements in the spaces and functions of the various medical facilities. Each generation of personnel assigned to the medical department of the 1st MAW has left its mark by distinctive refinements in the physical facilities of the dispensaries. Each medical unit is now in a semi-permanent building, and in most instances, all supply is now covered and protected with other than tenting. Additional supplies and equipment approaching garrison provisioning have been procured enabling the air group

dispensaries to participate in hearing conservation programs, have all the facilities for aviation physical examinations, and facilities for laboratory, pharmacy, X-ray and limited operating room capacity. Most of the air group dispensaries have bed space for limited short term inpatient care.

The following pages (in the basic pamphlet, *Ed.*) describe the physical facilities for each medical unit of the various parts of the First Marine Aircraft Wing, give a resume of the workloads, individual progress of the medical unit, the population served, and the particular medical refinements now in existence after 2 years in RVN.

(From a pamphlet published by the 1st MAW Jan 1968. Submitted by CAPT Oscar Gray, MC USN, Wing Medical Officer 1967–1968.)

EDITOR'S SECTION

BLOOD LIPOPROTEIN PATTERNS

High cholesterol or triglyceride levels in blood plasma are not necessarily a specific diagnosis, but rather may represent symptoms of any of at least five different lipid-transport disorders, each with specific symptoms, specific prognoses, and specific responsiveness to treatment, Dr. Robert I. Levy, of the Public Health Service's National Heart Institute, reported in San Francisco.

At the 17th Annual Scientific Session of the American College of Cardiology, he summarized recent findings of a research team that includes himself and Drs. Stephen Quarfordt, Virgil Brown, and Peter Kwiterovich, of the Laboratory of Molecular Diseases. Heading the team is Dr. Donald S. Fredrickson, Chief of the Laboratory and Director of the National Heart Institute, one of the eight National Institutes of Health in Bethesda, Maryland.

The NHI studies have produced a rational system for identifying and classifying excessive blood lipid levels on the basis of blood lipoprotein patterns. Cholesterol, triglycerides, and other lipids do not travel free in the circulation, but are bound to specific proteins. The resulting lipoproteins differ in density and also in electrical charge, which makes it possible to separate the lipoprotein classes by simple, low-cost electrophoretic techniques.

A sample of the patient's serum is spotted on a paper strip and placed in an electrophoretic cell containing an albumin buffer solution. The electric field set up in the solution causes the lipoproteins to migrate along the paper strip at rates proportional to their electrical charge. After a time, this migration results in several discrete lipoprotein bands.

Closest to the original spot are chylomicrons. These are the tiny fat droplets, composed chiefly of triglycerides, that impart a milky appearance to plasma after a fatty meal. They contain very little protein and so tend to "stay put" in an electric field.

The next two bands contain the pre-beta or very-low-density lipoproteins and the slightly heavier beta-lipoproteins. These lipoproteins carry chiefly triglyceride and cholesterol, and excessive blood levels of these two classes are associated with accelerated developments of atherosclerosis.

Traveling farthest from the original spot are the high-density alpha lipoproteins. This lipoprotein class causes no trouble. In fact, high blood levels of high-density lipoprotein appear to confer some measure of protection against athersclerosis.

Under the NHI system, most patients with elevated blood lipid levels fall conveniently under one or another of five types of hyperlipoproteinemia. These are often diagnosable before age 20 and, in some instances, can be detected at birth by testing samples of blood from the umbilical cord. Because these disorders are often genetically transmitted, diagnosis of one patient frequently leads to diagnosis of the same disorder in other members of his family.

Type I hyperlipoproteinemia is characterized by very high levels of chylomicrons. It probably stems from an inherited deficiency of lipoprotein lipase, an enzyme necessary for the breakdown and absorption of chylomicron triglycerides by the tissues of the body. Recurrent abdominal pain and the appearance of lipid deposits in the skin (xanthoma) are common symptoms. It is readily controlled by diets containing not more than 20% of total calories as fat. Low fat diets produce prompt relief of pain and rapid regression of xanthomas.

Type II is characterized by abnormally high blood levels of beta (low density) lipoproteins. It is quite common among Americans and, in fact, is probably responsible for most cases of "hypercholesterolemia" encountered by physicians. It may be a secondary manifestation of hypothyroidism or of high-fat diets, but often it is hereditary. The hereditary form is dominant and can usually be detected

in early life, sometimes at birth. This is fortunate because type II is frequently associated with premature development of coronary heart disease. Type II can be controlled by low-cholesterol diets or therapeutic diets combined with cholesterol-lowering drugs. Hopefully, such measures may reduce the patients' risk, especially if initiated early; for in affected families, a history of heart attacks before age 50 is not uncommon.

Type III hyperlipoproteinemia is less common than type II, but is by no means rare. It can be detected early by lipoprotein analysis; otherwise, coronary heart disease or peripheral atherosclerosis may be the first clinical indications of its presence. It is characterized by high blood levels of abnormal beta lipoproteins. Both blood cholesterol and blood triglycerides are usually elevated in type III patients. Type III is readily and completely controlled by balanced therapeutic diets and lipid-lowering drugs.

Type IV is characterized by an increase in very-low-density lipoproteins that have pre-beta motility on electrophoresis. Patients with type IV are frequently overweight and may be mildly diabetic. Symptoms are reduced or relieved by reduction in the amount of dietary carbohydrates plus caloric restriction to help the patient reach and maintain desirable weight.

Type V sometimes appears as secondary to other diseases, such as insulin-dependent diabetes, pancreatitis, or alcoholism. It can be identified as a mixed hypertriglyceridemia with an increase in both chylomicrons and pre-beta lipoproteins. Hyperlipoproteinemia can be minimized and symptoms decreased by a diet high in protein and directed to maintaining ideal body weight.

The NHI studies indicate that, in approaching the problem of blood-lipid elevations, lipoprotein patterns can provide important information not provided by analysis of blood cholesterol and triglycerides alone. In making possible the specific identification of five distinct disorders that were formerly lumped under the general heading of "familial hyperlipidemia" or "hypercholesterolemia," the NHI system offers a more systematic approach to the study, understanding, and treatment of these conditions.—USDHEW, National Heart Institute, Bethesda, Md.

AWARDS AND HONORS

Navy Cross

Work, Warren A., Jr., HM3 USN

Silver Star

Smith, Robert L., HM3 USN

Legion of Merit

Mahin, Harry P., CAPT MC USN

Bronze Star

Bridges, John M., HN USN
Gorsage, Walter R., Jr., HMC USN
Kundinger, John G., HN USN
Nelson, Richard A., HN USN
Olsen, James E., HM3 USN
Twehous, Gene L., HN USN

Navy Commendation Medal

Carter, Robert P., LT MC USNR
Eischeid, Raymond H., LT DC USNR
Parziale, Gerald J., HM3 USN
Sawyer, Robert N., LT MC USN
Stoll, Howard W., LT MC USNR

Letter of Commendation

Kaplan, Marvin I., HM3 USNR

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TO ALL HOSPITAL CORPSMEN UPON THE OCCASION OF THE 70th ANNIVERSARY OF THE FOUNDING OF THE HOSPITAL CORPS

As the Hospital Corps celebrates its 70th birthday, I wish to commend every man and woman of the Corps as you continue to serve valiantly in Vietnam or other foreign shore, in the air, on and under the sea, and here at home. For this exemplary service, in many instances above and beyond the call of duty, I extend to each of you the Navy's traditional "WELL DONE"!

Your contributions in preventing disease and caring for the sick and injured each passing year add new chapters to the proud history of your Hospital Corps.

Your young members, new to the Corps, prove to be as courageous, skillful and dedicated as the many men and women who have served before them. Your senior hospital corpsmen continue to set the highest examples of leadership.

On behalf of the Navy Medical Department, our best wishes for a Happy Anniversary and everlasting success in your mission of service dedicated to your country and to your fellow man.

R. B. BROWN
Vice Admiral, MC, USN
Surgeon General

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